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WHOLE NUMBER 167

GEOLOGICAL SERIES DECEMBER, 1929 VOL. IV. No. 2

NEW MEXICO MINERAL DEPOSITS EXCEPT FUELS

By ROBERT W. ELLIS

PROFESSOR OF GEOLOGY IN THE UNIVERSITY OF NEW MEXICO

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NEW MEXICO MINERAL DEPOSITS EXCEPT FUELS

By Robert W. Ellis

INTRODUCTION

With the exhaustion of the supply of former publications on the mineral resources of New Mexico, has come an increasing demand for information on that subject. In 1904 there was published by the Territorial Board of the Louisiana Purchase Exposition Managers of New Mexico a volume entitled "New Mexico Mines and Minerals." The information contained in this volume was collected and prepared by Fayette A. Jones. The volume is an invaluable reference on the history of mining in the State and on the distribution and development of minerals therein. It contains material that could not be duplicated at the present time, and it will always remain as an ultimate source of information on the development of New Mexico's mining industries.

The United States Geological Survey in 1905 undertook a reconnaissance of the ore deposits of New Mexico. The work was carried on and reports were prepared by Waldemar Lindgren, Louis C. Graton, and Charles H. Gordon, the whole being combined in Professional Paper 68, entitled "The Ore Deposits of New Mexico," published in 1910. This classic work will remain as a reference on metallic mineral deposits of all the mining districts in the State. The United States Geological Survey and the Bureau of Mines have also published numerous Bulletins and Geologic Folios in which the mineral deposits of certain localities are discussed.

In 1915, under the direction of the State School of Mines, Fayette A. Jones prepared a report, or bulletin, entitled "The Mineral Resources of New Mexico." This bulletin is a thorough summary of the important mineral deposits of the State and is useful as a convenient general reference.

Unfortunately, the first editions of many of these works have been exhausted, while it becomes continually more and more difficult for anyone to gain access to such references, except at public libraries. It was with a realization of this continued demand for information on the mineral industries of the State that the present writer undertook the work of preparing this bulletin. It is believed that information contained herein will be useful to mining men, in and out of the State, and to the general public. The report was prepared in 1926 in answer to the many inquiries coming to the writer for information concerning the mines and mineral resources of the State.

This report does not attempt to cover the whole field of mining within the State. The coal-mining industry has been discussed in several bulletins of the United States Geological Survey. All the important fields, as well as the areas of small production, have been thus specifically studied.

The oil industry is just now holding the most conspicuous position in the eyes of the public, and developments are being made in the production of oil. The public is in possession of a considerable amount of information on the oil industry, so that it is probably less in need of exploitation than is the metallic mineral industry or the fluorspar industry or the mining of mica, etc. The present report is, therefore, restricted to the treatment of the mining industries concerned with the production of metals and non-metals exclusive of oil, gas, and coal.

The general method of treatment is to give a brief statement of the history of mining, the geology, the mode of occurrence of the ores, etc., with data on present conditions, for every important mining district in the State. The discussion is by counties, under which the several mining districts, or individual mineral deposits, are considered.

The writer wishes to acknowledge assistance given in the collecting of material for this report. While each one can not be mentioned by name, there are many people in the localities visited who have, in one way or another, facilitated the work of the survey. Thanks are due to Dr. Fayette A. Jones, and to President E. H. Wells of the School of Mines, for valuable criticism and advice regarding the manuscript.

Developments in the mining industry since 1926 are treated in the Supplement, at the end of the report.

MINING DISTRICTS

A mining district is a certain area of territory centering around a particular locality where some metal is mined or prospected for, and whose boundaries are somewhat definitely designated, setting it off from adjacent districts. A district is named for some natural topographic feature, the central post office of the area, some town, etc. There are about 70 mining districts in New Mexico. Since many of these were organized, years ago, they have ceased to produce and have been practically abandoned. Others are still active or are important as future producers. In the present report an attempt was made to secure information on the present condition of every district, although many of the least important ones were not visited by the writer.

GENERAL STRUCTURE OF THE STATE

The geology of New Mexico is very complex. Most of the geologic systems are represented in the State and almost every type of rock structure may be found here. Sedimentation, intrusion, faulting, igneous extrusion, and erosion are processes that have operated at one time or another, with many repetitions and with many variations in order. It will be easier to understand any particular area if a brief resume of the general structural and stratigraphic conditions is first considered. Also, as the presence, the condition, and the origin of mineral deposits are closely related to the sequence and the mode of formation of the rocks, a better understanding may be had of the mineral deposits by first taking into account the geology.

Rocks of supposed pre-Cambrian age are exposed in many and in widely-separated places in the State. In a general way, the exposures of these rocks are enclosed within a belt one-third the width of the State at the north boundary, but widening southward, with its center a little east of the middle of the north line, extending a little west of south to the south line of the State in the longitude of Columbus. This belt also includes the main mountainous region of the State. To the east lie the relatively horizontal sedimentary beds extending beneath the Great Plains. To the west are comparatively undisturbed strata forming the eastern portion of the Colorado Plateau. Extrusive rocks of late geologic age cover large areas in each of these three regions.

The pre-Cambrian rocks consist of gneisses, schists, and quartzites, which have been uplifted, pushed aside, or intruded by great masses of granite and granite porphyry—much of which may be of post-Cambrian age. These gneisses, schists and quartzites—themselves the products of intense metamorphism—show subsequent distortion and folding. These are the rocks in which occur important mineral deposits. They probably underlie most areas now covered by sedimentary or volcanic rocks and are the basal formation. They are the rocks from which subsequent sedimentary deposits were derived. Islands of such rocks seem to have stood out of the early Paleozoic sea in the region of the Rocky Mountains, southward to the Sierra Caballo, and were gradually degraded to form sandstones and shales and even ultimately the limestones, of Paleozoic time. Certain large areas of the State seem never to have been submerged; or if they were submerged, the deposits were thoroughly worn away again. These areas are mainly in the northern two-thirds of the State. Around their borders lie the deposits of early Paleozoic periods. An encroaching sea shifted these sediments farther and farther over the edges of the land areas until they were buried nearly or quite to their tops. The deposits that thus covered the disappearing pre-Cambrian areas were, for most of the State, laid down in Pennsylvanian time. Deposits no later than the Devonian lie next to the pre-Cambrian in the south part of the State, as far north as Hillsboro, while the Mississippian has been recognized near Socorro. Beyond this, northward, the Pennsylvanian formation, for the most part, comes next above the pre-Cambrian. The Pennsylvanian also covers most of the State elsewhere.

Following the deposition of the Pennsylvanian sediments, slight uplifts of the Rocky Mountain area, with consequent erosion, accompanied by warpings and depressions in other regions, allowed the accumulation of extensive red-beds, gypsum, and salt. These deposits cover areas somewhat less in extent than those of the Pennsylvanian. Their outcrops appear in many parts of the State, in characteristic red sandstones or red shales. In some places the sea then deepened and thick beds of limestone were laid down. The period during which these red-beds, the salt, and the gypsum were formed is known as the Permian. Rocks of this series are sometimes confused with the Triassic, which also are red and gypsiferous; while some red sandstones formerly classed as Permian have been shown, by fossils, to be Pennsylvanian.

During the Triassic and Jurassic periods it is probable that the uplift of the central masses of the Rocky Mountain area increased gradually, with the continuation of displacements along certain fault lines, that had begun earlier. Areas of deposition were shifted somewhat and were considerably restricted. Gypsum and red-beds were formed, along with other types of sediments. Outcrops of this series occur in the northern part of New Mexico, where erosion and uplift have brought it to the surface.

With the close of the Jurassic period and the initiation of the Cretaceous, there began a submergence of the whole Rocky Mountain area. Cretaceous seas swept over lands that had been out of water since Pennsylvanian time, as well as over areas that had been later deposited. Several thousand feet of Cretaceous sediments cover the region of the Great Plains, and it is probable that great thicknesses of these rocks once overlay some of the upper slopes of the Rocky Mountains, where now only remnants are found. These deposits were not always marine, and wide areas of coal beds formed during this period indicate a peculiar condition of land surface. Cretaceous rocks are found over a large part of the State, in many places forming the uppermost sedimentary deposit. In the southern part, as at Santa Rita, the formation lies just above the Carboniferous.

The Cretaceous period was brought to a close by the main uplift of the Rocky Mountains. Not only was the area elevated bodily several thousand feet, but flexures and faulting took place along lines of previous displacements, as well as in other places. The resulting topography was naturally very rough. Many high ridges surrounded deep, undrained depressions. With a change of elevation came a change of climate and increased rainfall. A readjustment of deposits now set in, during which the prominences were worn down and the depressions were filled up.

Sediments of this period—the Tertiary— cover large areas in all parts of the State, and they are usually unconformable above the Cretaceous rocks. The deposits thus washed from the highlands filled the lower parts of the surface until the mountains themselves were partly buried beneath the debris. Subsequent erosion has cut deeply into these deposits regardless of pre-Tertiary topography, exposing Cretaceous, Jurassic, Triassic, Permian, and Pennsylvanian rocks. But in some parts of the State extensive areas of sub-aerial deposits of Tertiary and Quaternary time have not yet been trenched by stream erosion; while from their midst rise numerous isolated peaks and ranges—islands in a sea of sand. This condition prevails most commonly in the southern part of the State. The Florida Mountains with their surrounding semi-desert plains are an illustration.

During or closely following the great movement which elevated the Rocky Mountains, in the closing stages of the Cretaceous period, great quantities of magma moved toward the surface, cutting through all previously-formed rocks or doming them upward. Typical of these intrusions are the masses of monzonite and monzonite porphyry occurring so commonly in the mineralized zone. Such mountains as the Cerrillos Hills, the Ortiz, the San Pedro, and South mountains are examples of intrusions that have domed the overlying sediments and from which those sediments have been largely removed by later erosion.

These monzonitic intrusions seem to be the source of many of the metallic ore bodies of the central part of the State.

A little later, but still in early Tertiary time, came another upward-welling of igneous material, this time reaching the surface, in violent outbursts of volcanic dust, breccia, and flows of hot mud, or spreading as more or less viscous masses over wide areas—flow upon flow of rhyolite, andesite, or other felsitic rocks. Mount Taylor, the Valles Mountains, in the northern part of the State, and the mountainous district of western Socorro and Sierra counties and of Catron and Grant counties typify the results of this period of igneous activity. Volcanic dust deposits occur in many places in the State, and New Mexico volcanoes no doubt contributed to the great beds of this material found in Kansas and Nebraska.

Another period of general volcanic action occurred toward the close of the Tertiary, when flows of basaltic lava, extruded from many vents, spread widely throughout the State, regardless of areas of former disturbances, covering alike flat-lying sedimentary beds and previous volcanic deposits. The Mount Taylor plateau, and other extensive basaltic areas in the northern part of the State are examples of the earlier flows of basalt. Lava-flows of this type continued probably well into the Quaternary period. Some of the more recent flows, such as those along the valley of the San Jose River, near Laguna and Grants, certainly have come since the last glacial epoch; and perhaps no more than 1,000 years ago. The basaltic lavas are not productive of ores in this State.

During the Tertiary period the elevation of the Rocky Mountains continued, with the consequent rapid removal of material by running water. Except in the case of the most recent lava-flows, erosion has cut deeply into the uplifted formation, exposing the lower rocks, making a very rough topography, and bringing ore bodies to the surface; while the resulting alluvial deposits have been distributed upon lower levels.

GENERAL CONDITIONS OF MINING

In visiting the several mining districts of the State during the season of 1926, the writer was impressed by the attitude of hopefulness that prevailed in many districts or by the obvious signs of activity in some of them. Even in some of the most completely abandoned camps the feeling was often expressed that conditions there were improving. In many cases there seemed to be little to warrant the optimistic feeling, except the conviction in the mind of some old-timer that certain districts had never been worked out. Ruins of a once-inhabited and prosperous mining camp, dismantled and broken-down mills, and caved-in workings give an effect of decadence rather than of rejuvenation.

On the other hand, it can not be denied that there are evidences of renewed activity. New blood is coming in. Abandoned properties are changing hands and are being opened up. Fresh prospects are being developed. Improved methods of milling ores are helping some districts to dispose of ores that before could not be utilized. Rich strikes of metallic deposits in some districts are drawing attention of capital.

It is possible that metal mining in New Mexico will yet increase in extent and importance beyond former records. Areas in the little-developed territory of Hidalgo County give evidence of becoming important centers of copper and lead production. The placer deposits of Sierra County may prove more productive than the brilliant anticipations of promoters suggest. Mines that have never been worked out will doubtless yield surprising wealth to capital and energy. There are many instances where some prospector is property-poor, having a lot of apparently encouraging claims but without the money to develop them. On the whole, the outlook for the next few years is very hopeful, as far as metal mining is concerned.

The mining of non-metallic products, also, is rapidly increasing in importance and is being carried on more systematically than ever. Operations are very active in the development of fluorspar and mica deposits, of which the State has abundant supplies. Materials yet practically untouched are awaiting exploitation. Salt, gypsum, sodium sulphate, and potash; volcanic dust, obsidian, bentonite, and clay—these occur in more or less abundance in various parts of the State. Some of them are just beginning to be produced commercially; it is not likely that many of them will much longer remain exempt from commercial manipulation.

MINERAL INDUSTRIES OF NEW MEXICO

The total value of the mineral products of New Mexico in 1924 was $23,913,528. The principal mineral products in the order of their value were copper, coal, zinc, silver, gold, and lead. New Mexico ranked 29th among the States of the Union, in 1924, in mineral production; or it produced 0.51 per cent of the total for the United States. The following table shows the quantity and the value of the mineral production for 1924:

MINERAL PRODUCTION IN 1924

Product		Quantity	Value
Arsenious oxide	short tons	(1)	(1)
Clay products			$ 18,611
Clay, raw	short tons	3,596	13,603
Coal	short tons	2,786,063	9,774,000
Copper	pounds	71,691,436	9,784,578
Fluorspar	short tons	2,580	35,178
Gems and precious stones			(2)
Gold	troy ounces	24,804	512,735
Gypsum	short tons	(1)	(1)
Iron ore	long tons	189,371	(1)
Lead	short tons	1,817	290,761
Lime	short tons	2,386	23,975
Lithium	short tons	(1)	(1)
Manganese ore	long tons	775	(1)
Manganiferous ore	long tons	23,246	(1)
Mica			
Scrap	short tons	178	3,248
Sheet	pounds	29,803	6,583
Mineral waters	gals. sold	(2)	(2)
Molybdenum	pounds	(1)	(1)
Natural gas	M cubic feet		
Petroleum	barrels	98,000	127,000
Salt	short tons	1,700	17,000
Sand and gravel	short tons	526,787	267,110
Silver	troy ounces	795,070	532,697
Stone	short tons	654,610	432,023
Zinc	short tons	10,380	1,349,348
Miscellaneous[3]			1,438,961
Total value, eliminating duplications			$23,913,528

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1 Value included under "Miscellaneous."

2 No canvass for 1924.

3 Includes minerals indicated by "1" above.

DESCRIPTION BY COUNTIES

CATRON COUNTY

The most important metal-mining district in Catron County is the Mogollon. This district is in the southwestern part of the county, near the Arizona line. The district embraces a portion of the Mogollon Mountains, which are the most important group in the western part of New Mexico. The old camps of Cooney and Mogollon have been the principal sites of mining activities in the past. These are located on the western slope of the range, well up toward the top, and occupy adjacent canyons—Cooney in Mineral Creek Canyon and Mogollon in Silver Creek Canyon. The Wilcox district is about 15 miles southeast of Cooney.

The beginning of mining development in the Mogollon district was made under the harrassing opposition of Apache Indians from 1875 to 1880. Several of the early prospectors were killed, among them being Captain James C. Cooney and William Wilcox, whose names later distinguished the two mining districts. Captain Cooney discovered silver and copper in 1875, and was killed by the Indians on April 30, 1880.[1]

COONEY DISTRICT

The Cooney district includes the camps of Cooney and Mogollon. These camps are about 8 miles east of the San Francisco River; Mogollon is 10 miles from Glenwood. The proven ground of the district is about 5 miles north and south by 22 miles east and west. Access to the district is very difficult, even at the present time, owing to the steep and rocky roads leading from the river to the camps. Mogollon is 76 miles from Silver City, the nearest railroad station. For a considerable portion of the way, however, the road is graded. Settlements were made on the San Francisco River as early as 1880, and the sites of these old settlements have become the center of agricultural development as well as contributing to the picturesque beauty of the valley. The district has produced about $2,000,000.

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[1] Jones, F. A., New Mexico Mines and Minerals, pp. 129-131. 1904.

The Mogollon Mountains rise to an elevation of 10,500 feet and are 3,000 to 5,000 feet above the plateau in which they are located. Their drainage to the west is into the San Francisco River; on the east, into the Gila River. These mountains are much incised by erosion, and the topography is very rough. The San Francisco River has cut its valley deep into rhyolitic flows, which cover a large area in the southwestern part of New Mexico. Former levels of sediments that filled the ancient valleys are now indicated by high mesas, or terraces bordering the present valley. One of these upper levels is at least 600 feet above the San Francisco River, between Glenwood and Alma. About 400 feet below this is a second terrace, and 125 feet lower is a third, which is 50 to 25 feet above the river. These terraces show successive stages in the development of the present valley.

The geology of the Mogollon Mountains has not been fully described. One writer states that the range is a mass of granite. The prevailing rock in the south end of the range Graton[2] calls a soda rhyolite. The rocks observed along the road leading up the west side of the mountains to Mogollon are a reddish or purplish extrusive, apparently rhyolite or rhyolite tuff. Flow structure is noticeable in some places. It is possible that the range is made up of successive flows and deposits of this acidic type of extrusive, which is so common in the adjacent portions of the State. The individual flows may be only a few feet thick, while between the several flows are evidences of weathering and erosion and soil formation, indicating a considerable length of exposure to the atmosphere following each flow.

Andesite occurs to some extent, but being of a more basic composition, the flows were more quiet, and brecciated phases are not so common as in the rhyolite. The andesite is darker in color, usually greenish or grayish green.

Basaltic flows are not common in the Cooney district, but where occurring are in thin sheets.

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[2] Graton, L. C., Professional Paper 68, U. S. Geol. Survey, p. 192, 1910.

These extrusives comprise several thousand feet in some parts of the district. After the out-pouring of the lavas the region was faulted into irregular blocks. It is supposed that mineralizing solutions closely followed the faulting.

ORE DEPOSITS

The ore deposits of the Cooney district occur as veins in the rhyolite and andesite rocks. The principal metal is silver, which occurs as the sulphide, argentite. Gold and copper also occur; the latter in the form of bornite and chalcocite. The chief gangue is quartz. Graton thinks the important minerals of the veins were deposited contemporaneously, in open cavities, from solutions that were the final product of the igneous magma that supplied the flow of extrusive rocks. There is no evidence of secondary enrichment. Replacement has occurred to some extent in the wall rock.

The veins belong to two systems, one trending to the north, the other to the northwest or at right angles to the first. The second class of veins seems to be the most productive of valuable ores. Of the productive veins, some yield a predominance of silver, while in others copper is the most important. These two classes of veins have much in common, however. The ore occurs in shoots or pockets, with a very low grade of ore occurring in other parts of the vein.

MINES

Mining in the Cooney district has not been very active in recent years, and at the present time only one mining company is operating; this is the Deadwood Mines, Glenwood, N. Mex. This company is operating under the management of the Trio Mines Co. of New York.

The Deadwood Mines Company is developing the Deadwood, the Gold Dust, and the Iron Bar mines, near Mogollon. The ore is said to occur in contact lodes, and consists of argentite and gold in a gangue of quartz and calcite. The ore body is 7 to 30 feet wide. Shafts in these mines reach 200 to 780 feet in depth. It is believed that large ore bodies occur at greater depth.

The amount of development in the mines as stated by Mr. Henry J. Jooy, agent, amounts to 25,000 feet, in shafts, winzes, and levels. An old 60-ton cyanide mill is on the property but is not now in operation. It is estimated that this group of mines has yielded $650,000. The concentrates were formerly shipped to El Paso for reduction.

The mine of the American Silver Corporation is said to have yielded approximately $10 per ton in gold and silver. This property is now in the hands of a receiver.

The Mogollon Mines Company, owners and operators of the Last Chance mine since 1912, is now in the process of liquidation. The mine is being dismantled. The Confidence, Alberta and Fanney groups were under lease and operation by this company.

WILCOX DISTRICT

This district was discovered by William Wilcox, in the fall of 1879. The Wilcox district has not been very productive, but there are numerous prospects. The geology of the region is similar to that of the Cooney district, the principal rocks being rhyolite porphyries and andesite.

The Gold Lode, owned by G. M. Messick, Buckhorn, N. Mex., is about 55 miles from Silver City. Ores of gold and silver are said to have assayed as high as $500 per ton. The vein is said to be 3 to 20 feet wide, and a tunnel has been opened a distance of 65 feet on the vein.

The Red Dog, the Red Dog No. 2, and the Blue Jay camps are in the southern part of the county, about 50 miles from Silver City. These claims are owned by Grant Roberts, Buckhorn, N. M., and A. E. Lockwood, Glenwood, N.

Mex. Gold and silver ore from these prospects is said to assay as high as $50 per ton. No development work has been done.

The New Strike, the Big Spar, the Log Cabin, the White Flag, and several other prospects are located 6 miles east of Glenwood, on Little Whitewater Creek, and about 70 miles from Silver City. These claims are under the management of Jesse Campbell, Glenwood, N. Mex. Assay values of ore are said to run as high as $300 per ton in gold. The gold is free-milling. About $4,000 worth of development work has been done and considerable ore is ready for shipment. This property will be near the new graded highway now being built to Silver City.

FUTURE OUTLOOK

Under present conditions, the future outlook of the Mogollon mining district is not very bright. The increased cost of labor and supplies and the low price of gold and silver are claimed to be prohibitive of the paying operation of these mines. Added to this is the distance from railroad, and poor roads. With ample capital some of the old mines and new prospects might develop into paying investments.

Mr. H. L. Kelley, postmaster at Mogollon, thinks there are large possibilities for future development since, of 30 miles of surface indications of veins, work has been done on only 3 linear miles. He believes there is an unlimited amount of $5 and $6 ore in the Mogollon district. The Deadwood property "has a 100-per cent chance of a comeback, and prospects are good for other properties."

The Oaks Company, of Mogollon, during the summer of 1926 was negotiating in New York for funds to drive the Oaks tunnel 1,400 feet. This would top the Queen lead at about 1,200 feet depth, right under the town of Mogollon, and would open an undeveloped zone 500 feet deeper than any other in the district. Water power could be developed on Whitewater Creek sufficient for working all equipment —at least 1,000 horse-power throughout the year, if ample storage were provided.

OTHER MINERAL DEPOSITS

Numerous deposits of minerals other than metallic ores are reported from various parts of the county. Jesse Campbell, of Glenwood, reports a deposit of "fibrous talc" covering several claims, with a thickness of 2 to 4 feet.

"Alum" deposits are said to occur 4 miles from the Silver City highway, in Little Dry Canyon, 15 miles southeast of Glenwood.

A deposit of salt of commercial importance occurs in a crater lake 20 miles northwest of Quemado. The mode of occurrence is unique. A low, broad elevation of basalt rises above the plain to a height of probably 75 feet. Within the center of this elevation is a depression about 175 feet deep, with steep sides and flat bottom. This depression, which seems to be the crater of an extinct volcano, is about 3 miles in diameter. A large part of the floor of the crater is covered by a shallow lake, heavily charged with salt and containing beds of precipitated salt.

Within this crater and toward the south side of it there are two volcanic cones, which rise about 125 feet above the surface of the lake, but are not entirely surrounded by it. One of these interior cones has a crater reaching below the level of the lake and about 700 feet across the top. At the bottom of the inner crater is a small lake of salt water, of unknown depth. The level of the inner and the outer lakes is practically the same all the time.

It is supposed that the salt of these lakes is supplied from underlying salt beds, that have been pierced by volcanic action. The outer lake doubtless gets its salt from the inner crater lake. The outer lake receives considerable surface drainage; thus, in times of heavy rains, this lake becomes so much freshened that salt-harvesting is hindered.

Mr. W. G. Henderson, postmaster at Salt Lake, has harvested and has on hand a pile of salt comprising 20,000 cubic feet. In a dry season 3,000,000 or 4,000,000 pounds can be harvested; some years are too rainy to allow any gathering of salt. There is no market for the product except locally for stock.

COLFAX COUNTY

Colfax County lies partly in the westward extension of the Great Plains and partly in the Rocky Mountains. The lofty ranges of Mora, Taos, and Culebra mark the boundary line between Colfax and Taos counties, whence the mountains slope eastward to the broad Moreno Valley. Parallel to these ranges, east of the Moreno Valley, is the Cimarron Range, whose most pronounced peak—Baldy—is a landmark in the region.

From the top of the Cimarron Mountains, Cretaceous sedimentary rocks dip eastward, gradually flattening out beneath the wide-stretching plains. A large area north of Cimarron is covered by Tertiary deposits, while the eastern portion of the county is overlain by basaltic flows, of which the high mesas north and east of Raton are a part.

The most important mineral wealth of the county is the coal that underlies the northern part, around Raton. The mountains in the western part contain the historic mining district of Elizabethtown, producer of placer gold.

ELIZABETHTOWN DISTRICT

The Elizabethtown district is located in the Cimarron Mountains, with Baldy Peak as a central feature. The elevation of Baldy Peak is 12,491 feet, which is about 4,000 feet above the valley to the west. Elizabethtown is situated on the west side of the Moreno Valley, west of Baldy Peak, and 18 miles from the railroad at Ute Park.

According to Jones,[3] gold was discovered in the Moreno Valley in October, 1886. The discovery was made by a party of men sent to do some assessment work on a copper property near the top of Baldy Peak, who found rich placer deposits on Willow Creek, where they had camped for the night. The discovery caused great excitement throughout New Mexico and Colorado, and the influx of prospectors rapidly built up the town of Elizabeth, which became the first county seat of Colfax County.

The problem of an adequate water supply for working the placers was solved by the construction of a ditch leading across the mountains from the Red River. This was a great piece of engineering, for the distance was 41 miles and the route of the ditch was over very rough country. The ditch was completed in 1886, at a cost of $230,000, including storage facilities on Red River.

The Elizabethtown district has been the most important gold-producing region in the State. It is estimated that the total production up to 1905 aggregated $5,000,000. Elizabethtown is now partly abandoned and mining activity in the district is rather quiet. Some new prospects are being opened up and work is expected to begin again in some of the old mines.

GEOLOGY

The geology of the district is difficult to interpret. Rocks of Pennsylvanian age occur on the west side of Moreno Valley. At the top of the Cimarron Range is a thick series of Cretaceous rocks, while between are several repetitions of the Cretaceous beds, and exposures of red beds that are supposed to be of Triassic age. There are also, in some places, exposures of pre-Cambrian granites, gneisses, and schists. In certain places a monzonite porphyry appears as an intrusion into some of the sediments. In some places

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[3] Jones, F. A., op. cit., p. 141.

Cretaceous rocks are said to rest directly upon the pre-Cambrian; in others, a thick wedge of monzonite separates the pre-Cambrian from the Cretaceous, as at the head of Cimarron Canyon.

The most apparent structural feature is that the Cimarron Range, with old Baldy, consists of the upturned edge of a faulted block dipping to the east, which has raised the Cretaceous sediments 4,000 feet above the Moreno Valley, where they form the crest of the range. Covering the eastern slope, these sediments merge into the plains beyond. The uplift did not take place along a single fault plane, but was distributed through several; so that there is a repetition of the same series of formations down the western front. It is supposed that the Moreno Valley was formed by the combined downthrow of the series of faults, whose intervening blocks were tilted similarly eastward, thus bringing their upturned edges to the surface successively, westward. Such a series of faulting would bring the underlying pre-Cambrian rocks into view in several places along the fault scarp.

Closely following the faulting, the region was intruded, and probably further uplifted, by large masses of monzonite porphyry. One of these masses, or sills, of porphyry forced its way between the pre-Cambrian rocks and the Cretaceous sediments, while smaller ones crowded between the sediments, causing more or less metamorphism of them. It is evident from the relative positions of the Cretaceous formations that, just prior to the submergence during which these formations were laid down, the pre-Cambrian core of the Cimarron Range was a land area; and, indeed, may never have been wholly covered by sedimentary deposits. The faulting and major uplift of the mountains came, of course, after Cretaceous time. Since then, erosion has carved out the present system of canyons and removed much material from the higher elevations, forming alluvial deposits, and placers, at the foot of the mountains.

ORE DEPOSITS

The mineral production of the Elizabethtown district is essentially gold, though some silver and copper occur, and traces of molybdenite have been found. The ore deposits may be classed as of three types, two of which are primary; the other is derived from these two, and is thus secondary in origin. The secondary type is the placer deposits. The primary deposits are quartz veins and contact-metamorphic deposits.

PLACER DEPOSITS

The placer deposits have been the source of most of the gold of the district. Those deposits on the west side of Baldy Peak have been more productive than those on the east side. At the present day, the alluvial slopes of Baldy Peak bear evidence of the enormous amount of sluicing done in the past to recover the gold in these placer deposits. Here was directed the water of the big ditch, and the surface gravel has been torn away in places to the bed rock.

QUARTZ VEINS

The quartz veins seem to be closely connected with the intrusion of the Monzonite porphyry. They are found in the porphyry and also in the sedimentary beds. One of the most productive veins—that of the Aztec mine—is in Cretaceous sediments. The veins are generally only a few inches wide, or less.

The principal gangue is quartz, and pyrite is the chief metallic mineral. It is supposed that the gold is carried by the pyrite, which upon oxidation leaves the gold free. Some alteration of the country rock has occurred in proximity to the veins. It is the veins that have supplied the most of the gold of the placer deposits.

CONTACT-METAMORPHIC DEPOSITS

The contact-metamorphic deposits are of less importance than the quartz veins. They generally occur in sedimentary beds at the contact of the monzonite porphyry and are the result of the heat and possible exudations of the intrusive mass, combined with the rearrangement of the chemical constituents of the sediments themselves.

RED BANDANA MINE

Placer deposits are not the only source of gold on the west of Baldy Peak; a number of mines have been opened on veins here. The Red Bandana is a well known property, consisting of 6 or 7 claims lying in Grouse Gulch, half a mile southeast of Elizabethtown. This mine was first worked out as a placer, to a depth of 30 feet. Later a lode was discovered, which was followed by a shaft 100 feet deep. Still later a deeper shaft was put down, which opened up still richer ore. This property is now under litigation but is considered equal in richness to the Aztec lode.

LEGAL TENDER MINE

The Legal Tender mine, located on the east side of Willow Creek, has produced a considerable amount in gold and silver. This mine is on a quartz vein.

AJAX MINE

The Ajax mine is near the Legal Tender. This is a contact-metamorphic deposit in shale, which has been much altered. The ore is disseminated through the shale, occuring with pyrite.

BALDY TUNNEL

One of the most fascinating engineering propositions connected with mining in New Mexico was the attempt to tunnel through Baldy Peak. The purpose was to tap a rich ore body outcropping higher up on the side of the mountain. At the time of visit this tunnel was 6,200 feet long. Work had been suspended for a few months, but it was the intention of the owners to continue the tunnel through to the other side of the mountain, which would be some 3,000 feet farther. The portal of the tunnel is at an elevation of about 10,400 feet, or 2,100 feet from the top of Baldy Peak.

The prevailing rock on the upper western slope of Baldy Peak is Cretaceous shale. Farther in, igneous rocks were encountered. At 3,500 feet from the portal a vein of molybdenite 4 to 6 feet thick was penetrated. Here the tunnel is 1,400 feet from the top of the mountain. The ore is said to occur in a diorite. The last 300 feet of the tunnel is in quartzite.

KLONDIKE MINE

The Klondike mine is 4 miles northwest of Therma, on the west side of the Moreno Valley. This property is owned and operated by the Ideal Mining Company. Gold, copper, and silver are said to average here about $40 per ton. The mine was opened 6 to 7 years ago but it has not produced. Development to the amount of 1,600 feet has been done on two leads or fissure veins, one 16 feet wide, the other 12 feet wide. The ore occurs in a limestone formation—probably of Carboniferous age. A mill has been constructed for treatment of the ore. This mine is 18 miles from the railroad at Ute Park.

AZTEC MINE

There are a number of mines and prospects on the east side of Baldy Peak—as Black Horse, Montezuma, Rebel Chief, French Henry Mountain, and Aztec. All of these are said to have produced considerable gold. The mode of occurrence at the Black Horse and the Montezuma is in veins in porphyry; at the Rebel Chief, the ore is at the contact of a porphyry sill with shales.

The Aztec mine is located on the east of Baldy Peak, well up on the side of the mountain, 8 miles northwest of Ute Park station. This is one of the most noted mines in the district. The ore deposit was discovered and opened in the sixties. It closed down in 1870, after taking out, it is said, $1,000,000. The mine was reopened in 1912 and it continued in operation till 1920, in which time $2,000,000 was taken out. It is estimated that in all, the mine has produced $6,000,000.

This mine has been under the control of several ownerships. At present it is owned and operated by the Maxwell Land Grant Company, of Raton, N. Mex. At the time of visit, the mine was not in operation but preparations were being made to open up work again.

The ore occurs at or near the contact of Montana shales and the overlying coarse Laramie sandstone. The shales are black and fissile. The ore bodies vary in size from a few inches to a foot in thickness, from a few feet to 100 feet in width, and as much as several hundred feet in length.

The ore is mined by several miles of tunnels, drifts, cross-cuts, and raises. A mill is located at the mine, where the principal mode of extraction is by amalgamation.

CIMARRONCITO DISTRICT

The Cimarroncito district is about 14 miles southeast of Elizabethtown and is rather remote. The ores are of the contact-metamorphic type, in limestone near porphyry. Several mines were developed to a small extent, years ago, but the production of the district has never amounted to very much.

DONA ANA COUNTY

Dona Ana County includes a portion of the semi-desert area of southern New Mexico. A large part of the county is relatively level and sandy. The monotony of the arid plains is broken by the Portillo Mountains, in the southwest, while extensive areas of Tertiary extrusives occupy the northwestern part. The San Andres Range, including the Organ Mountains, extends southward near the east line of the county. The intervening plain is trenched by the valley of the Rio Grande, which extends diagonally southeast through the center of the county. The surface drainage consists of many dry watercourses reaching from the mountains to the river or to some undrained portion of the plains, where their waters are taken into the thirsty sands or remain as ephemeral lakes.

The section of the Rio Grande valley included in Dona Ana County is one of the most productive parts of the State, agriculturally. The "Mesilla Valley," fertile and well-provided with water, is intensively farmed and is known beyond the borders of New Mexico.

The county is important as a mineral producer. The Sierra Cabello, in the northwest, and the Organ Mountains, in the southeast, are potentially productive of a variety of minerals, perhaps beyond what they have already yielded.

ORGAN MOUNTAIN DISTRICT

The principal mining district in Dona Ana County is that of the Organ Mountains. The Organ Mountains form part of the long, more or less disjointed range reaching from the Sandias, in Bernalillo County, to the Franklin Mountains, in the southern part of the State. The Organ Mountains continue on the north in the San Andres Range, an uplifted fault-block of sedimentary rocks, dipping to the west, with an eastward-facing escarpment. The Organ Mountains are formed largely by an intrusion, of a granite type, which has uplifted the Paleozoic sediments, tilting them eastward and westward or leaving them arched across the summit of the uplift. The major portion of this range is formed of the bare granitic core, rising to a height of 7,000 to 9,000 feet. Weathering agencies have eroded this mass in such a manner as to leave high, isolated peaks, which have suggested the name of the range. The range is about 30 miles long and 5 to 12 miles wide.

The intrusive rock is properly a quartz monzonite. Some geologists have considered it of pre-Cambrian age and that the Paleozoic sediments were laid down against it. Lindgren,[4] however, has found that the monzonite is later than the Carboniferous sediments that rest upon it. It is possible that a combination of these assumptions is true, and that the igneous mass at its highest part was an island in Paleozoic seas; while subsequent uplifts have brought it, with the enveloping sediments, to its present elevation. Contact-metamorphism has occurred in the limestones adjacent to the monzonite, indicating intrusion or movement after the limestones were laid down. Both the sedimentary rocks and the quartz monzonite are cut by numerous dikes. There are two systems of shear zones—one east and west, the other northeast and southwest. The latter are generally more gold-bearing; the other contain copper and lead predominantly.

ORE DEPOSITS

The ore deposits are of three types—fissure veins, replacements in limestone, and contact-metamorphic deposits. The first of these is more common on the east side of the range, often along dikes. They contain more or less silver, lead, zinc, gold, and molybdenite.

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[4] Lindgren, Waldemar. Ore Deposits of New Mexico. U. S. Geol. Survey. Prof. Paper 68, 1910.

The replacement type of deposit follows the stratification of the limestone, which is not metamorphosed. The most important examples occur on the west side of the range. The principal primary ore is a silver-bearing galena.

Deposits of the third type occur along the contact of limestone and quartz monzonite, mainly on the west side of the mountains. The deposits follow the stratification and are irregular in size and shape. The chief primary ores are chalcopyrite and bornite, in a garnetized and coarsely-crystalline limestone. Considerable chrysocolla occurs in some mines.

The total production of the district was estimated at $2,500,000 prior to 1900. L. B. Bentley[2] estimates the production of four mines at $3,000,000 to $4,000,000.

The productive area of eastern Dona Ana County is 60 miles long and 8 to 20 miles wide, with a concentration of productivity around Organ. Within 10 miles of Organ are 200 mines and prospects that have ore on the dump. Besides the ores of copper, silver, lead, and gold, there are important deposits of molybedenite, wulfenite, and bismuth. Mr. Bentley considers an area extending from Oregon north for 50 miles as the richest bismuth district in the United States. The bismuth occurs as the sulphide and the carbonate. Amphibole asbestus, muscovite, sodium sulphate, and kaolin are also said to occur in the Organ district.

DESCRIPTION OF MINES

Some of the more important mines of this district are the following: Stephenson-Bennett, Memphis, Torpedo, Little Buck and Gray Eagle. The Memphis and Torpedo are located on the west side of San Augustin Pass, just east of the village of Organ. The Stephenson-Bennett is on the west side of the mountains, about 2 miles south of Organ; and the Little Buck is about 2½ miles northeast of Organ.

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[2] Personal communication.

The Stephenson-Bennett mine, according to Jones,[6] was discovered in 1849. The early mining operations were very crude and were hampered by the Apache Indians, yet between 1854 and 1857 over $80,000 was produced. The total production to the present time has been $2,000,000 or $3,000,000.

The deposit is a typical replacement in limestone and is said to consist of two bedded veins following the stratification. The primary ore is galena, with some sphalerite and pyrite. Considerable secondary deposits also occur. These ores carry large values in silver.

Of the contact-metamorphic type, the Torpedo mine is a notable example. This mine is about 50 rods east of Organ post office, on the south side of a small arroyo. The mine has been developed to the 300-foot level and has produced $800,000. The present owner is the Torpedo Mining Company, E. J. Foster, agent, Las Cruces, N. Mex.

The ore occurs in the contact between the monzonite and the limestone, as a replacement, and in fissures, and consists of chrysocolla, malachite, and some sulphides of copper. The principal values are in copper and silver, with gold yielding 25 cents to $2 per ton. The ore body is 250 by 800 feet in area.

There are three shafts, the deepest being 500 feet, with considerable drifting and stoping. The property is 15 miles from the railroad at Las Cruces, and ore can be hauled by truck at a cost of $3 per ton. No work is now being done.

MEMPHIS MINE

The Memphis mine is located about half a mile north of Torpedo mine. This mine was a producer for many years since 1886, but is now idle. The ore is chalcopyrite, chalcocite, and malachite.

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[6] Jones, F. A., op. cit., p. 73.

BIG THREE MINES

The Big Three mines, 14 miles east of Las Cruces, are owned by J. H. Johnson, George M. Lerchen, and the C. B. Gill estates, of Las Cruces, N. Mex.

The ore is said to occur as a replacement in limestone and in fissures in "granite." The principal ores are copper and lead, all carrying values in silver. Both oxidized ores and sulphides occur. The size of the ore body has not been determined. The development consists of two shafts about 100 feet deep and about 300 feet of tunnels. The total production is said to be $35,000, but there is no production at present.

GALLOWAY MINE

The Galloway mine, Henry Foy, owner, is located half a mile northeast of San Augustin Pass. This mine has produced about $55,000.

The country rocks are said to be granite, with rhyolite and porphyry dikes cutting the granite. The ore occurs in a contact fissure vein about 6 inches wide, between rhyolite and granite. The principal ores are argentite and cerargyrite in quartz, yielding from $100 to $5,000.

A small amount of development work has been done, amounting in all to about 400 feet. There is no mill or other equipment.

OUTLOOK

The outlook for the district can not be said to be very encouraging. While there are undoubtedly rich deposits of ores yet undeveloped, and rare metals in profitable quantities for exploitation, there is a certain lethargy of interest in the district on the part of men with capital. There is no mining being done, except a little prospecting in three places, and not over 10 men are employed in the whole district.

TORTUGAS DISTRICT

The Tortugas Fluorspar Company, F. M. Hayner and S. Manasse, operators, has a fluorspar property 6 miles east of Mesilla Park, N. Mex. The ore is said to occur in a vein in limestone. There is a shaft 286 feet deep and a drift about 1,100 feet long, with considerable stoping.

The ore is concentrated by jigs and picking belts, and is shipped as far east as Pittsburgh, Pa., and to the Pacific coast. About one carload of ore per week is mined, and there has been a steady production for 7 years. The outlook seems to be favorable for a small, steady production for many years.

PITTSBURG DISTRICT

The Pittsburg district lies on the east side of the Rio Grande, toward the south end of the Sierra Caballo. Part of the district is included in Sierra County. The district has been known mainly as a producer of gold, which was derived from placers a few miles east of Shandon and Pittsburg. Gold was found here about the beginning of the present century. At the present time, other minerals than gold are being exploited in the district.

About 1½ miles west of Rincon is the Morgan group of manganese mines. This group is owned and operated by H. D. Hill, of Hatch, and Dr. A. C. White, of Hot Springs, N. Mex.

The ore occurs as replacements and veins in sedimentary rocks. It is said to yield 45 per cent manganese, with a value of $19 per ton. The ore body extends over an area of 600 by 1800 feet. The ore is mined by open cuts, at the rate of one carload per month. The total production is about $15,000. During the summer of 1926, plans were being considered for installing a concentration plant. The manganese deposits of this district have been described by Wells.[7]

EDDY COUNTY

PHYSIOGRAPHY

Eddy County occupies an intermediate position between the western edge of the Staked Plains and the eastern foothills of the Sacramento and Guadalupe mountain ranges. The portion of the county east of the Pecos River is a moderately-rolling tableland rising rather abruptly from the Pecos Valley to a height of 200 to 250 feet above the valley. The western part is rough and mountainous. Immediately west of the Pecos River, for most of its distance throughout the county, the surface is relatively flat for a distance of 6 to 20 miles. The Pecos River, flowing southeastward through the middle of the county, receives from the west the principal amount of the water that enters it as surface drainage; the gypsiferous beds to the east of the river may contribute to the river by underground drainage, but there is a remarkable absence of surface streams from the east. The mountainous country to the west receives a greater precipitation than does the land to the east, and thus it is a contributing source for both surface and artesian water-supply in the Pecos Valley.

GEOLOGY

Limestones of Permian age form the mountainous part of the county. These strata, outcropping at the west, dip gently eastward beneath the Pecos Valley, where they are lost to view below formations of later age. The uplifted areas of these limestones are frequently cavernous, and it is here that such phenomena as Carlsbad Cave are found.

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[7] Wells, E. H., Manganese in New Mexico; State School of Mines Bull. No. 2., pp. 35-39, 1918.

To the east of the Pecos River, the formations are largely a series of red beds, gypsum, and salt, in many successive layers. Solution in the upper members of this series has disarranged the continuity of the beds to a considerable extent, but the lower beds are more persistent and can be better relied on as indicators of stratigraphic similarity and of definite horizons.

The flat central area west of the Pecos River is made up pretty largely of alluvial material which, for most part, is silt-like in texture, as if being the deposit in shallow ancient lakes. Along the water courses now trenching these deposits, gravel and boulders from the western mountains have accumulated. An area extending from the south end of Lake McMillan to the vicinity of Carlsbad is rough and rocky, and seems to have acted as a natural barrier to the accumulating water above, in which these silts were deposited ages ago—perhaps in middle Tertiary time. Southward and westward from Carlsbad extend the deposits of a similar lake. Certain isolated structures rise like islands in this alluvial plain.

The general eastward dip of the sedimentary rocks in this region is disturbed by north and south faults. One of these fault zones runs near the Pecos river. It has caused a discontinuance of the artesian system east of the river in the latitude of Artesia; and it may be responsible for the direction of the river there.

POTASH BEDS

Eddy County contains no mining districts; agriculture and grazing have been the principal industries until recently. The production of oil is now an important industry here. In addition to these, a new industry promises to become one of the most important in the State. Deep drillings into the Permian red beds of western Texas and eastern New Mexico have revealed the presence of potash in commercial quantities. Doubtless, other wells will bring to light the presence of these salts, and the limits of the most productive zones of the deposits will be defined by core-drilling.

SNOWDEN-McSWEENEY TEST

The Snowden-McSweeney Co. recently completed a core-drill test on the McNutt prospecting permit in Sec. 4, T. 21 S., R. 30 E. Samples of material from this test were analyzed by the U. S. Geological Survey, with the result of finding 10 groups of potash beds of possible commercial importance.

The most important potash mineral discovered is polyhalite, but several beds of sylvite, and other potash salts, were found. This locality was the first place in the United States where sylvite was recognized by the U. S. Geological Survey.

The upper bed containing potash is 795 feet from the surface, and the deepest deposit reached by the drill is about 1,890 feet. The richest bed is one of sylvite 2 feet thick, at a depth of 1,365 feet, which contains 18.5 per cent of K2O. The most important group commercially is at the relatively shallow depth of 988 feet, below which are two beds of polyhalite 2 feet 8 inches and 2 feet 7 inches thick, separated by a bed of common salt 2 feet 4 inches thick.

GRANT COUNTY

GENERAL FEATURES OF SURFACE

The northern part of Grant County occupies a portion of the plateau province. As far south as Silver City the general surface is high and mountainous. Extensive flows of rhyolite, andesite, and basalt cover the sedimentary formations, and later erosion has deeply dissected the region, leaving a very rough topography. The Mimbres Range, lying between Grant and Sierra Counties, is the general southeastern limit of the plateau province. The Pinos Altos Mountains form the center of a broad mountain group lying north and east of Silver City. The Burro Mountain group, southwest of Silver City, is largely made up of pre-Cambrian rocks, which have been cut by porphyry intrusives. The Gila River drains a large portion of the northern area. The waters of the Mimbres river are carried out to the desert plains of Luna County, where they are lost beneath the surface.

The southern part of the county is mainly a semi-desert plain, broken by a few low isolated groups of elevations. The surface drainage is intermittent, the water from the higher elevations being taken up by the desert sands.

WHITE SIGNAL DISTRICT

The White Signal district is on the south side of the Burro Mountains. White Signal post office is on the main highway 29 miles from Lordsburg and about 9 miles from Tyrone. Some gold, copper and turquoise have been found in this district and a little ore has been shipped.

The only mine in the district, visited by the writer, was the radium mine of Otto Forrester. This mine is located about 1 mile south of White Signal post office, on the Lordsburg road. It was formerly mined for gold.

The ore occurs in a felsite dike cutting granite, or granodiorite. An area 1½ miles long and 1,500 feet wide is said to be mineralized. A shaft 215 feet deep follows the dip of the vein, and some stoping has been done. A gangue of white, talcose material encloses the ore, which appears as light green films or thin veins ramifying the gangue. The ore mineral is known as torbernite, a hydrous phosphate of uranium and copper.

Both the torbernite and the gangue are utilized commercially, the former as an ore of radium and the latter as a toilet powder. The ore from this mine is shipped to Briar

Cliff Lodge, New York, where it is placed in the bathing pool, for its radio-active properties. The ore is worth about $25 per ton. Its curative powers for rheumatism and similar ailments are claimed to be very high. A 10-pound bag of the material placed in drinking water is said to give marvelous results for restoration to health.

It was Mr. Forrester's intention to install a 200-ton concentrating plant at the mine.

BURRO MOUNTAIN DISTRICT

What is known as the Burro Mountain mining district is situated about 13 miles southwest of Silver City. This is the region famous for its turquoise mines. Both turquoise and copper occur here.

The Burro Mountains consist, for the most part, of pre-Cambrian granite and diorite, intruded by masses of monzonite porphyry. The copper occurs in both the granite and the monzonite porphyry.

The principal mode of occurrence of the copper deposits of this district is said to be impregnations and replacements along irregular fractures and zones of crushing. Secondary enrichment is distinct. Lean chalcopyrite ores occur in the crevices of the shattered porphyry. In the enriched zone, the chalcopyrite is replaced by chalcocite, or copper glance. The principal production comes from this zone. The oxidized zone contains some carbonate ore and native copper. The oxidized zone extends to a depth of about 50 feet. The ore bodies are large and are said to occur mainly at the intersections of important fracture systems.

PHELPS-DODGE MINE

The present most important mine in the district is that of the Phelps-Dodge Corporation, Burro Mountain branch, located at Tyrone, 14 miles southwest of Silver City. The location is naturally picturesque, combining a rugged topography with a considerable forest vegetation; and the camp is neat and well arranged. The mine has elaborate equipment and is connected by a branch railroad with the A. T. & S. F. line.

At the present time only development work is being done; active operations ceased in April, 1921, on account of the slump in the price of copper.

The rocks of the area are granite, intruded by a large mass of monzonite porphyry. The ore occurs as disseminated chalcocite in both granite and porphyry, within the zone of secondary enrichment. The ore consists mainly of copper, with some silver. The average yield is 2 per cent of copper and 0.10 ounce of silver per ton. Some oxidized ores are utilized.

The development has reached about 7,000,000 tons and the available tonnage is said to be large. Most of the production comes in the 500 and 600-foot levels. A 2,000-ton gravity and flotation mill concentrates the ore about 10 to 1. The concentrates are reduced at the Douglas smelter.

This mine has produced approximately 60,000,000 pounds of copper. The future outlook is considered favorable.

SILVER FLAT DISTRICT

An area situated about 1½ miles southwest of Silver City has been lately developed as a mining district. The only claims at present being developed are leased by the Colorado Fuel and Iron Company, of Denver.

SILVER SPOT MINE

The Silver Spot mine is located on T. 18 S., R. 14 W., 1½ miles from the railroad station at Silver City. This prospect had been operated only about three months at the time of visit. The area is a low, round-topped hill, whose surface is strewn with weathered boulders of iron ore. The soil itself is a dark brown color, indicating a considerable iron content. A much-corroded limestone outcrops on the slopes of the hill. The limestone seems to be intruded by a rock resembling monzonite, which has probably locally affected the sedimentary beds, giving rise to the mineral deposits. At one place on this hill the drill penetrated 30 feet of limestone, then 60 feet of ore, reaching limestone again at a depth of 90 feet.

The ore consists of manganese and iron. Both magnetite and hematite occur. The ore is said to occur just below the Percha shale, as a replacement along the fractures or joint planes of the limestone. The ore yields 30 to 35 per cent iron, 10 to 15 per cent manganese, with 0.014 per cent phosphorous. The deposit is still undeveloped, but it is believed that the deposit offers good prospects for profitable mining for the next 10 years. The geology and mode of occurrence of manganese deposits in this district have been described by Wells.[8]

CENTRAL DISTRICT

The Central district officially includes the region around the towns of Central, Hanover, and Santa Rita. With copper at Santa Rita, iron at Fierro, and lead and zinc at Hanover, the district constitutes the richest metal producing area in the State and one of the oldest mining regions of the West. The copper mines of Santa Rita, according to Jones,[9] were known as early as 1800. By the summer of 1869 there are said to have been 57 mining claims recorded in the district.

GEOLOGY

The sedimentary rocks consist mainly of Carboniferous limestones and quartzite. Rocks of Devonian and Ordovician age are said to occur near Georgetown, and Cretaceous beds appear near Central.

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[8] Wells, E. H., op. cit., pp. 39-51.

[9] Jones, F. A., op. cit., p. 34.

Intrusive rocks of two main types occur. The earlier of these and the largest in area is called a quartz diorite porphyry.[10] It extends from Fort Bayard eastward to a point about half a mile west of Santa Rita, varying in width from 1 to 2 miles. It is of laccolithic form, appearing in some places as sheet-like masses between sedimentary beds. A similar mass more than a mile square occurs about a mile east of Santa Rita, just east of the "Kneeling Nun." The rock is greenish-gray, fine grained, and contains small phenocrysts of quartz and feldspar.

A later but more important intrusive, commercially, is known as a granodiorite porphyry or quartz monzonite porphyry; which are closely related as to composition and texture. The central mass of the Big Burro Mountains is of the quartz monzonite porphyry type, while a rock closely resembling this type occurs in the Pinos Altos Mountains and has been called a granodiorite. At Santa Rita, and between Hanover and Fiemro, along Hanover Creek, are outcrops of a similar rock.

The masses of this rock in Hanover Valley and the Santa Rita basin are much weathered and have worn away more rapidly than the surrounding rocks. The rock is light gray in color, and contains phenocrysts of quartz, feldspar, and biotite. The granodiorite porphyry is intrusive into the quartz diorite porphyry and the sedimentary beds that overlie it.

The effect of this intrusion on the igneous rocks has been very great. Hot, upward-moving solutions have traversed the rocks in every direction, depositing secondary silica and changing the mineral constituents of the original rocks. Magnetite also occurs in the granodiorite, at its borders.

The sedimentary rocks also have been metamorphosed. The principal sedimentary rocks of the region are the Fierro limestone, of Carboniferous age, the Beartooth quartzite, of Cretaceous age, and the Colorado shale, also of the Cretaceous. The intrusion of the granodiorite into the sedimentary beds has caused the formation of mineralized zones along the contact. Garnet, epidote, pyroxene, pyrite, chalcopyrite, magnetite, and other minerals have thus been developed in the limestone. The metamorphism of the limestone at Santa Rita is similar to that at Fierro. The Colorado shale at Santa Rita has been changed into a porcelainite, that is very resistant to weathering and might be mistaken for the Beartooth quartzite.

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[10] Paige, Sidney, Silver City Folio, U. S. Geol. Survey, p. 7, 1916.

There are numerous faults in the district. One of these passes northeastward from Cobre, with the downthrow to the southeast. Another runs nearly due eastward from Santa Rita, and its downthrow is to the south. About a mile north of Fierro, just south of Hanover Mountain, there is a fault, with a northeastward strike and a downthrow to the northwest.

SANTA RITA MINE

The copper mine at Santa Rita has become one of the most important mineral-producing areas in the State. This mine is said to have been discovered by the Indians, about 1800. According to Jones,[11] the mine was first worked in 1804, by a Spanish merchant of Chihuahua.

The ore deposits occur, for the most part, in the quartz monzonite porphyry (or granodiorite), in which they seem to have been deposited as copper-bearing pyrite in the closely-fractured rock. Subsequent enrichment has taken place, and it is these enriched portions of the mineralized body that have furnished the main production of ore. The original pyritic ore has been changed to carbonates, oxides, native copper, and chalcocite. A great abundance—10 per cent of the total ore—of native copper occurs, and mostly in the upper 150 feet. The most abundant ore mineral at present is chalcocite, and this is a replacement of the pyrite in the minute crevices of the porphyry. The zone of secondary enrichment extends to a depth of 300 feet; and in places it is much deeper than this.

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[11] Jones, F. A., op. cit., p. 35.

Developments in this camp are very extensive. An area of at least 100 acres has been excavated to a depth of 300 to 400 feet. The mode of operation is exclusively by open pit. The ore-bearing porphyry is taken out by steam shovels and loaded directly upon freight cars, which carry it to the concentration mill at Hurley, 11 miles distant. The mill has a capacity of 10,000 tons daily, and the ore is concentrated 20 to 1. The copper content of the original ore averages 1.5 per cent.

HANOVER FIERRO BASIN

The structure of the Hanover-Fierro district is essentially an immense core of granodiorite porphyry intrusive into a series of sedimentary beds of Carboniferous age, which has resulted in the uplift and metamorphism of the sedimentary rocks. Erosion has laid bare the underlying porphyry mass. The exposed edges of the uplifted outward-dipping sedimentary beds form steep escarpments facing the valley of Hanover Creek. This structure is ended at the north by a fault, with the downthrow to the north; the southward extension of the anticline continues as a fault.

Metamorphism due to the intrusion of the porphyry has occurred along the contact, within the sedimentary rocks and to some extent in the intrusive. The metamorphism resulted in the formation of epidote, garnet, quartz, magnetite, sphalerite, and other minerals. The distribution of these contact minerals is not the same for all parts of the metamorphosed area, it being in general more siliceous toward the north. Magnetite is more abundant toward the north, while sphalerite occurs mostly in the southern part of the basin; more copper also is found toward the south.

At Fierro, the ore body on the west slope is 15 to 50 feet thick, being richest near the intrusive. A zone of garnet lies between the intrusive and the ore body, and on the other side of the ore body occurs a zone of serpentine of irregular thickness. The side of the ore body toward the intrusive is quite even, but on the limestone side the ore extends out into the limestone in pockets and stringers, making an irregular contact. On the opposite side of the valley of Hanover Creek, the structure and deposits are somewhat the same, except that on this side a sill of hedenbergite lies between the sediments, just above the Fusselman limestone.

The ore at Fierro consists of magnetite, with some copper. At the outcrop, the slopes are covered with rounded pebbles of ore.

The most important mine of the Fierro camp is the Republic. Other mines on the west side are Union Hill and Hugo; and on the east side, the Jim Fair, the Eighty-Six and the Snow Flake, while farther south are Cupola and the Philadelphia. The Philadelphia produces more copper and less iron than the mines to the north.

The principal production of iron ore comes from the west side of the valley. Tunnels extend along the strike of the ore body for a mile or more; the east side is not being worked. The Republic is producing 700 to 800 tons of ore per day. The ore is crushed and sorted, and when run into the cars is about the size of potatoes. The ore is shipped to Pueblo, Colorado, furnaces.

Zinc is the most important ore at Hanover. According to Graton,[12] bodies of almost solid sphalerite containing a very little pyrite and galena . . . replaces white, crystalline limestone. Considerable carbonate ore has been mined, but the prevailing ore now is the sulphide. The deposits occur in irregular cavities and fissures in the limestone, close to the contact of the limestone and the intrusive, and are thought to be, for the most part, contact-metamorphic deposits.

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[12] Graton, L. C., U. S. Geol. Survey Prof. Paper 68, p. 313, 1910.

The mine of the Empire Zinc Company, of Hanover, produces ore yielding 15 per cent zinc sulphide. At these workings there are about 10,000 feet of drifts, cross-cuts, etc. The ore is concentrated by magnetic separations and the product is shipped to Canon City, Colorado.

One mile south of Hanover is the group of mines of the Black Hawk Consolidated Mines Company, of Silver City. The Combination mine is located in a southeastward-dipping monocline, which is broken by several faults. The ores occur as replacements in the Carboniferous limestone and consist of the sulphides of zinc and lead, carrying a little silver. About 5,000 feet of development work has been done.

PINOS ALTOS DISTRICT

Pinos Altos is rather remotely situated in the Pinos Altos Mountains about 8 miles northeast of Silver City, at an elevation of 7,000 feet. According to Jones,[13] gold was discovered in the district in 1860. The place was first called Birchville, after the discoverer. In 1883 a mill for the mechanical concentration of ores was erected, it being the first in the State. The total production to January 1, 1904, is given as $4,700,000.

The geology of the district is thus described by Paige[14]: "A roughly elliptical mass of granodiorite intrudes a complex of diorite porphyry and associated dikes; fissure veins have been formed in both masses and cut across their contact without interruption, and to the north, trachyte and other lavas of later age than the veins cover the intrusive masses." The diorite porphyry forms the crest of Pinos Altos Mountains, while the granodiorite occurs east of the main mass of the mountains. Sedimentary beds of Pennsylvanian and Cretaceous age cover a small area about 2 miles northwest of Pinos Altos, on the west side of the mountains.

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[13] Jones, F. A., op. cit., p. 47.

[14] Paige, Sidney, U. S. Geol. Survey Bull. 470, p. 109.

The granodiorite is a reddish looking rock, resembling granite. Border phases of this rock vary in color and composition, some containing more biotite and pyroxene.

The diorite and diorite porphyry, into which the granodiorite is intruded, are dark-greenish rocks, of fine-grained texture, with more or less abundant phenocrysts.

The lava-flows which cover both the granodiorite and the diorite porphyry northeast of Pinos Altos are lavender-colored rhyolites of variable texture; such as cover large areas in the western part of the State.

Two types of ore deposits occur in this district—fissure veins and replacements. The replacement deposits are found in the limestone beds on the west side of the mountains. These deposits consist of sphalerite, chalcopyrite, pyrite, quartz, and iron-bearing carbonate. These ores are found in the Cleveland group of mines. Assays from the Cleveland mines show 2 to 5 ounces of silver, 1 to 2 per cent of copper, 18 per cent of zinc, with some gold.

The fissure veins, for the most part, run north or northeast, with steep dips both east and west. They cut the diorite porphyry and the granodiorite. The structure of these veins indicates open-fissure filling, and there are beautiful examples of comb structure. The vein ores averaged about $30 per ton, the values running $14 in gold, 7 ounces in silver, 2.5 per cent zinc, 1.3 copper, and smaller amounts of lead.

SAVANNA AND CALUMET-NEW MEXICO MINES

The Savanna and the Calumet-New Mexico properties, located near Pinos Altos, are under lease to Messrs. Ryan and Armstrong, of Pinos Altos, who are mining and milling 25 tons of ore per day.

The ore occurs in fissure veins in diorite and diorite porphyry, and the veins are 8 inches to 3 feet wide. The ores are gold, silver, lead, zinc, and copper, mainly in the sulphides.

In the Savanna there are several miles of tunnels and shafts; in the Calumet-New Mexico, only a few hundred feet. The ore is concentrated at the mine, about 5 to 1, and the concentrates are sent to El Paso and Amarillo. A truck haul of 9 miles brings the ore to the railroad at Silver City.

During recent years mining had declined, owing to the composite character of the ore and the difficulty of separating the metals. The future outlook, however, is very promising, on account of the application of the flotation process to the treatment of the complex ores; which may make possible the profitable handling of these ores. Renewal of activity is apparent and development work is going on in a number of mines in the district.

OTHER DISTRICTS

Other districts in Grant County show little, if any, activity. This is true for Chloride Flat, Georgetown, Lone Mountain, Black Hawk, Telegraph, and Steeple Rock districts. There is no large production in the Victorio district, though recently various leasers have tried to bring this old district back to productivity.

VOLCANIC DUST

So important are the metallic ores found in Grant County, that any non-metallic deposits seem almost insignificant. There are, however, certain other deposits that are likely sometime to become important commercially. A conspicuous example of such material is found along the west side of the valley of Duck Creek, in the northwestern part of the county. Deposits of volcanic dust occur here, extending for several miles along the highway a few miles above Cliff. These deposits are 20 to 50 feet thick and seem to be of quite pure material.

HIDALGO COUNTY

The essential characteristic of topography of Hidalgo County is a desert plain from which rise numerous mountain ranges, trending generally north and south. The region is being aggraded by the removal of material from the mountains and its deposition upon the broad, intervening undrained areas, as coarse or fine alluvial material—according to the distance from the mountains. At times of sudden and heavy rains, the lower parts of these "bolson" valleys are covered with playa lakes, in which fine mud is deposited. The structure of these mountains is complicated and diverse. In some places the uplifts seem to be due to faulting and tilting of sedimentary beds; and in others, to the intrusion of granitic rocks.

APACHE NO. 2 DISTRICT

The Apache No. 2 district embraces a group of low hills about 9 miles southeast of Hachita. These hills seem to consist of a quartz porphyry, which is traversed by many metalliferous veins.

The only producing mine in this district in 1905 was the Apache. Ore was shipped from this mine, yielding 3 to 4 per cent of copper, $1 to $1.50 in gold, and 6 ounces in silver. At the present time there are a number of prospects being developed to some extent. There are many leads in the region, and most of them carry lead, silver, and copper.

Mr. C. D. Beeth, Bisbee, Arizona, has developed a deposit 8 miles from Hachita. The deposit occurs in a fissure vein, and consists of lead, silver, gold, and copper, averaging about $30 per ton. The vein is 20 to 30 inches wide, is nearly vertical, and is of undetermined length. No ore has been shipped from this claim. The prospects are good for future development if capital sufficient were available.

EUREKA DISTRICT

The Eureka district is located 8 miles west of Hachita, in the foothills of the Hachita Range. The district was discovered about 1880. For a few years after the building of the El Paso and Southwestern railroad, in 1902, the production was nearly $25,000 annually. Several mines have produced more or less intermittently. The Copper Dick mine is said to have produced several hundred thousand dollars. The principal ore in this mine was copper, averaging about 10 per cent.

The Cactus group, of 9 claims, is located 10 miles west of Hachita. This property is being developed by R. M. Reynolds, of Lordsburg, N. Mex. It surrounds the old Copper Dick mine. The ore body has a thickness of 2 to 6 feet, and the assay value of the ore is said to be copper 20 per cent, gold 0.05 ounce, and silver 4 ounces.

SAN SIMON DISTRICT

The San Simon district embraces a portion of the Peloncillo Range near the Arizona boundary line.

The Granite Gap mine, owned by E. A. Montgomery, Steins, N. Mex., is 12 miles south of Steins, on the highway. The mine was developed many years ago and has been the principal producer in the district. Its estimated production up to 1905 was $600,000.

The ore occurs along the contact of a light-gray granite porphyry dike dipping about 65 degrees to the north. The ore seems to be a replacement in a blue limestone, occurring in irregular pockets, mainly along the hanging wall above the dike. It also occurs abundantly around tongues of the porphyry projecting into the limestone. The chief ore is cerussite. This mine is producing, and it offers promise of ore deposits below the present development, which may exceed the former production.

CARBONATE HILL MINE

A newly developed property consisting of 25 unpatented claims, called the Carbonate Hill group of mines, lies about 24 miles southwest of Lordsburg and 6 miles southeast of Steins. The location is in the foothills on the east slope of the Peloncillo Mountains. The present owners, the McGhee brothers, of Steins, N. Mex., have held the property for 10 years and have done considerable development work. There is a shaft 630 feet deep, with 5,000 to 6,000 feet of workings.

The country rock consists of andesite and phonolite. Limestone outcrops on the slopes below the mine. The ore seems to occur as a replacement in igneous rocks. The mineralized zone is 1,200 feet wide and extends for a distance of 2 miles. The direction of the outcrop is a little north of east.

The ore consists mainly of lead, which carries a little silver. Both the carbonate and the sulphide occur. The deposit is very rich, averaging $10 to $12 per ton of lead, with variable amounts of silver. Copper and vanadium also occur. Some lodes contain almost exclusively zinc ore. From January 1, 1926, to July of the same year, 150,000 tons of milling ore was produced.

This is one of the most promising mines in the county, and the property is drawing the interest of the large mining companies.

LORDSBURG DISTRICT

The Lordsburg district embraces two camps lying toward the north end of the Pyramid Mountains. The one at the south end of the district is known as Pyramid camp, and the one at the north end is the Virginia, or Shakespeare. The district extends from Lordsburg south 8 or 10 miles. This is an old mining district, mining having begun here about 1870. At first, silver was principal mineral sought, cerargyrite being the most important silver ore. Later, copper was produced.

The prevailing rock of the Pyramid Mountains seems to be andesite; there is no limestone. The surrounding flat areas are covered with desert wash.

The ore deposits are fissure veins, varying in width from a few inches to several feet; with a siliceous gangue. In some mines the ore averages 75 per cent silica. The ores contain values of copper, lead, zinc, gold, and silver.

Several mines in the district have produced in the past, and some of these are now being worked. One of the largest producers was the old Leidendorf mine. This mine is near the south end of the district. The production here is said to have reached $150,000, mostly in silver.

The old Last Chance mine adjoins the Leidendorf on the south. It has been worked intermittently during the last 40 years, producing, it is said, $100,000 in silver. The mine has lately been re-opened and it is now shipping ore to the smelter.

Other mines located in this (Pyramid) district are the Viola, the Robert E. Lee, and the Nellie Bly. In all, these properties are said to have produced about $1,000,000 in copper and silver.

Located on what is called the Master Lode Vein system are the following mines: The Miner's Chest, the Bonney, the Nellie Gray, the Eldorado, the Anita, the Phoenix group, the Eighty-Five, the Atwood, the Jerry Boyle, the Waldo, the Lister, and others. The Master Lode Vein system is said to have produced about $13,000,000.

The Bonney mine, about 5 miles from Lordsburg, is said to have produced $500,000. The ore is very high grade, carrying copper, silver, and gold; assay values were $40 to $100 per ton. There is a small amount of development—a shaft 300 feet deep, etc.

The Anita No. 2, located on the highway 8 miles south of Lordsburg, was in operation just before the visit of the writer. The ore is copper, with some silver and gold. The property includes a flotation plant at the mine, and some of the ore is milled there.

EIGHTY-FIVE MINE

The most extensive mining operations at present are at the Eighty-Five mine. This camp is 3 miles southwest of Lordsburg, toward the north end of the Pyramid Mountains. The little town of Valedon has grown up around this mine. The mine is owned and operated by the Calumet and Arizona Mining Company.

The ore occurs in a fissure vein in andesite and monzonite. The oxidized zone, extending to a depth of 50 to 200 feet, carries galena, copper oxides and carbonates, gold, and silver. Below water-level chalcopyrite and bornite prevail, carrying gold and silver. There is a continuous vein averaging 6 feet in width extending a depth of 1,700 feet and outcropping for about 2,500 feet. The ore is siliceous, carrying copper 2.75 per cent, gold 0.10 ounce, and silver 1 ounce per ton.

The deposit has been developed extensively; there is a shaft 1,650 feet deep, cross-cutting 4,900, and raising 8,900 feet. The present production is 9,000 tons per month. A branch line of railroad connects the mine with the Southern Pacific and the El Paso and Southwestern railroads at Lordsburg. The ore is shipped to the Calumet and Arizona smelter at Douglas, Arizona. This mine has good prospects for future development.

ATWOOD MINE

Between the Eighty-Five mine and Lordsburg is the Atwood mine. This mine is said to have produced much ore, and it is still producing, under lease. The ore is of good grade, yielding copper, gold and silver.

GOLD HILL DISTRICT

The Gold Hill district is located 12 miles northeast of Lordsburg, in the Little Burro Mountains. Gold is said to have been discovered in this district in 1884. The prevailing rocks of the district are pre-Cambrian gneiss and schist, intruded by granite and diabase dikes. The ore, consisting mainly of gold and silver, occurs in veins in these rocks. The principal gangue is quartz.

Mining has gone on more or less continuously, and on a small scale, up to the present. Frank G. Cline still operates a two-stamp mill at the mouth of the canyon leading up to the Co-operative mine.

CO-OPERATIVE MINE

The Co-operative mine, H. C. Walter, president and general manager, is located about 15 miles northeast of Lordsburg. It is reached by a good road for the most of the way; the last 3 miles is up a sandy arroyo. The elevation of the mine is a little over 6,200 feet, which is 2,000 feet higher than Lordsburg.

The ore occurs in a fissure vein in granite, the vein varying in thickness from 2 inches to 8½ feet. The vein strikes north and south, and dips 38° to 40° E. The principal ore is silver, with some lead. The average values of ores are 90 ounces in silver, $1.30 in gold, and 8 per cent in lead.

Development has proceeded 500 feet down the dip of the vein; but there is no cross-cutting yet. About 1,200 tons of ore have been put out, and this was treated in an 80-ton flotation mill at the mine.

The Gold Hill district holds good possibilities for the future. There are many potential claims, controlled by eastern capital.

LINCOLN COUNTY

In general, Lincoln County is mountainous or rough. Toward the northeast the surface is a moderately even plain. The main mountain area is the northward continuation of the Sacramento range, and it has a steep westward front, with a generally eastward dip of sedimentary formations. This uplift combines the White Mountains—at the south—the Tres Cerros, and the Jicarillas. Sierra Capitan commands a prominent outlook over the central part of the county and is a landmark for many miles. A long tongue of basalt fills the middle of the valley to the west of these mountains. The drainage of most of the county is toward the Pecos Valley.

The county has produced some metallic and non-metallic minerals in the past, the present production is not very noticeable. The principal non-metallic material has been coal. Several areas of coal have been exploited, and in 1903 nearly 100,000 tons were mined. Gold has been mined in the Nogal, the White Oaks, and the Jicarilla districts.

NOGAL DISTRICT

The Nogal district is situated in the southwestern part of Lincoln County, centering around Nogal Peak. Nogal, the principal post office, is located about 11 miles southeast of Carrizozo. The district is divided into several sub-districts, but the geology and ore deposits are similar for these sub-districts. Placer gold was discovered in Dry Gulch between Nogal and Nogal Peak in 1865.[15] About 1880 systematic prospecting had begun. For a number of years rich deposits of lode ore were opened up; but for many years there has been little production, and operations are practically at a standstill.

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[15] Jones, F. A., op. cit., p. 168.

GEOLOGY

The Sierra Blanca range consists of a batholith of monzonite porphyry, that has broken up through Cretaceous and older sediments, now bordering it on the west, north, and east. The monzonite is cut by dikes of a more basic rock. There are also deposits of extrusive rocks, as andesite and andesite tuff. The Nogal district occupies the north end of the Sierra Blanca and its east side.

ORE DEPOSITS

Two types of ore deposits are said to occur in this district. The first of these is represented in the American and the Helen Ray mines. It is a fissure vein type, occurring in the monzonite porphyry and later intrusives. The veins often contain shattered portions of the wall rock. The metallic minerals are pyrite, sphalerite, galena, and a copper sulphide.

The second type of ore is found in the Hopeful mine, a mile northwest of Nogal Peak, and in the Vera Cruz mine, 4 miles north of Nogal. This mode of occurrence is a sort of blanket deposit, a much-altered phase of the country rock of wide areal dimensions and extending to a depth of 120 to 260 feet. The gold occurs free and is rather uniformly distributed through the rock. The method of mining is therefore by open cut.

At the present time there is little mining activity in this district. Some prospect work is being done on lead and silver properties in the White Mountain, or Scheelerville, section of the district.

WHITE OAKS DISTRICT

White Oaks district is included in the area called the White Oak Mountains, Baxter Mountain being the most prominent member. White Oaks camp is located at the foot of Baxter Mountain, on the east side, 12 miles northeast of Carrizozo. A total production of $2,860,000 is stated by Jones, up to January 1, 1904.

GEOLOGY

The area consists essentially of sedimentary rocks, as late as the Cretaceous, which have been intruded and uplifted by a mass of monzonite. Both sedimentary beds and monzonite have been cut by subsequent intrusions of basic dikes.

ORE DEPOSITS

The ore occurs in veins that cut the dikes, the Cretaceous shales, and the monzonite. These veins are comparatively narrow, but they are frequently closely-placed and connected by stringers, making workable lodes, pockets, and shoots. The principal gangue is quartz and pyrite, while in some of the mines an unusual combination of minerals occurs—such as quartz, albite, fluorite, tourmaline, pyrite, and huebnerite. It is supposed that mineralization followed closely the intrusion by the basic dikes and that hot, upward-moving solutions from the hot monzonite magma charged the veins with their present mineral content. The principal ores are tungsten, and free gold. The total gold production of this camp is estimated at $3,000,000 to $8,000,000.

MINES

There are numerous mines in the district. These are generally dry, even at a depth of over 1,300 feet. The oxidized zone does not coincide with the present water-level. The best known mines are the Old Abe, North Homestake, South Homestake, Little Mack, and Smuggler.

The Old Abe is famous for its record as a gold producer. One estimate places the total production of this mine at $3,000,000. The Old Abe vein strikes N. 10° W. and dips steeply toward the west. The shaft is about 1,400 feet deep, and when abandoned, 15 years ago, was producing paying ore from the bottom level. The ore occurs in a blue limestone, in a lead 4 to 18 inches thick. The pay streak is 100 to 150 feet long. The mine has not been kept in repair, and the workings have caved in.

The North Homestake and the South Homestake are on the same vein. They were at first worked as one mine, but after a disagreement between the owners, one of the prospectors took the south end of the vein and the other the north end. This lode strikes nearly north and south, and dips steeply to the east. Mr. A. A. Lane, of White Oaks, owns an interest in these mines. The South Homestake shaft is 760 feet deep, and a tunnel 160 feet lower runs into the shaft. Some drift work was done on the South Homestake 2 years ago, but it has been 8 years since the mine was producing. The North Homestake shaft is 960 feet deep. At the bottom is a drift 150 feet to the west, and then a winze 450 feet deep. These two mines are supposed to have produced a total of $4,000,000 or $5,000,000.

The Little Mack prospect has a shaft 100 feet deep. A lot of low-grade ore is said to be in sight. This property is owned by Judge Hewitt, of White Oaks.

Production at the South Homestake mine is said to have stopped when a certain company, having possession of it, gutted the mine and left it without any attempt to develop it. Unfavorable financial conditions in the United States, during the period, also hindered a revival of activity. Development of other mines was prevented by litigation, from the effects of which they have never recovered. At present gold-mining is handicapped by the high price of supplies, machinery, etc.

RITA GROUP

The Rita group is owned by A. H. Hudspeth, Carrizozo, N. Mex. This also is located on Baxter Mountain. The mode of occurrence of the ore is similar to that of other mines in the district. Gold and tungsten are produced. There are several shafts—100 feet, 228 feet, 429 feet, and 725 feet deep, respectively—and 4,000 feet of drifts. It is believed that this property justifies expenditures in search for ore bodies, and the owner has a small force of men at work.

JICARILLA DISTRICT

The Jicarilla mining district embraces a group of rounded hills at the north end of the Sierra Blanca, called Jicarilla Mountains. The post office of Jicarilla is 7½ miles southeast of Ancho, on the Southern Pacific railroad.

GEOLOGY

The geologic conditions of this district are similar to those of the White Oaks. The monzonite porphyry here is traversed by many joints, and the ore deposits occur along some of these joint planes, with a gangue of pyrite and quartz. The pyrite contains gold, and when it is oxidized, gold can be panned out of the gangue. The ore is said to have yielded from $1.20 to $400 per ton in gold, with some silver.

PROSPECTS

The district is not producing at present, though there are said to be several good prospects. John Laskowsky, of Jicarilla, has a good property. M. H. Price owns various groups of claims—such as the Alaska, the Eldorado, the Atlantic, and the Rainbow. He claims a heavy tonnage of ore running from $5 to $50 per ton. While not producing now, Mr. Price thinks there is a good outlook for the future. In addition to the lode ore, placer gold, platinum, and other rare metals are reported from this district; besides, copper, lead, silver, manganese, and iron.

GALLINAS DISTRICT

The Gallinas, or Red Cloud, district is in the Gallinas Mountains in the northwestern part of the county. This district has not been a large producer in the past, but at present some development work is being done, on the property by James A. French and Co., Santa Fe, N. Mex. This is producing about 3 tons of ore per day. The camp was worked for silver in 1881; and since that time, has been worked only when lead and copper were at a high price.

RED CLOUD MINE

The ore at the Red Cloud mine consists of lead, silver, and copper, which occurs in fissure veins in limestone and porphyry. The ore is said to average $30 per ton. There are three shafts in the camp, with a depth of 200 feet or over, and many prospects not so deep.

TECOLOTE DISTRICT

About 16 miles south of Corona and adjacent to the Southern Pacific railroad is a large deposit of iron ore. This deposit has been mined to some extent, but mining was discontinued in 1919, on account of the exorbitant increase in freight rates.

The deposit lies along the south side of the railroad for a distance of a mile or more, and probably some distance to the north of the railroad. An intrusion of diorite (?) porphry has uplifted the sedimentary beds and is exposed as a series of low, rounded hills extending several miles westward from the railroad. The ore seems to occur as a replacement in limestone at the contact of the diorite. The ore body is 4 to 10 feet thick; and there seems to be an immense tonnage. The ore is said to average 55 per cent iron.

These mines were operated for 4 years, the ore being shipped to Pueblo, Colorado. The present owner, Lon Jenkins, Corona, N. Mex., is desirous of disposing of the property, on account of lack of capital for developing the claims.

LUNA COUNTY

Luna County embraces a portion of the semi-desert region lying along the international boundary. The general topography and structure are similar to those of Dona Ana and southern Grant counties, between which it is. For the most part, the surface is a sandy plain from which rise numerous isolated mountain masses, whose bases are buried beneath fragmental debris washed from the higher elevations. There is a general north-south trend to these mountain ranges, and it is likely that many of them were formed by the same geologic processes and in the same period.

One of the largest of these ranges is called Cooks Range. This is in the northern part of the county, being the southward extension of the Mimbres Mountains, and reaches one-third the way across the county. The most conspicuous part of this range is Cooks Peak, 8,408 feet high; it is a landmark for many miles around. The Little Floridas, the Floridas, and Tres Hermanas groups may be considered as an extension of the Cooks Range, partly buried in the desert plain. Other prominent mountains are the Cedar Grove, extending southeastward across the southwest corner of the county; the Carrizalillo Hills, a continuation of the Grove Mountains toward the south; the Good Sight Mountains on the eastern border 15 miles east of Cooks range; and the Victorio Mountains, in the west-central part.

The rain that falls over the desert plains is absorbed at once by porous soil. That from the mountains is frequently carried out upon the level surface for some distance, where it sinks into the sands or remains a short time as a shallow lake. The principal drainage courses are the Mimbres River and the Palomas Arroyo. These channels are dry for the most of their length, except when flooded by a heavy rainfall. The Mimbres does not carry water much farther than a few miles east of the Florida Mountains. Palomas Arroyo carries its flood waters across the international boundary 4 miles southeast of Columbus and into small lakes in Mexico.

GEOLOGIC STRUCTURE

As a large part of the surface is covered with wash from the mountains, the major part of the foundation structure can not be ascertained. It is upon the numerous outcrops as mountains that any interpretation of structure rests.

Cooks Range is made up of Paleozoic sediments intruded and uplifted by porphyries. The range is divided by a fault which passes along the east side of the range, cutting through it to the west 4 miles southwest of Fort Cummings. To the west of the fault are Paleozoic and Cretaceous sediments, while to the east of it are Tertiary agglomerates and sheets of extrusive igneous rocks.

The Little Floridas are a succession of agglomerates and felsitic lava-flows, dipping gently eastward. The Floridas consist essentially of a central core of granite, intrusive into and uplifting Paleozoic sediments and Tertiary agglomerates. The main dip is eastward. Numerous faults cross the range east and west.

The Tres Hermanas have a central mass of granite porphyry—an entirely different rock from that forming the core of the Florida mountains. This is flanked by upturned Pennsylvanian limestones and Tertiary extrusives.

The Cedar Grove mountains are mainly extrusive Tertiary rocks—latite, rhyolite, agglomerate and basalt—having the general dip of structure toward the northeast. The Victorio Mountains are mainly northward-tilted sediments of Paleozoic age and Tertiary extrusives. Cow Spring Hills and Grandmother Mountain, in the northwestern part of the county, are made up of rhyolite flows. The Klondike Hills, near the west side of the county, consist of Paleozoic limestones dipping eastward. At the west end is an exposure of Tertiary rhyolite. The Good Sight Mountains are a series of Tertiary agglomerates overlain by basaltic flows.

To the southwest of Cooks Range at a distance of 1 to 2 miles is a low range called Fluorite Ridge. The central core is a monzonite porphyry, which is intrusive into and which uplifts Paleozoic and Cretaceous sediments and Tertiary agglomerates. Numerous other small elevations occur in the county, some of which are formed of Paleozoic sediments and some of Tertiary extrusives.

COOKS PEAK DISTRICT

Cooks Peak district comprises an area extending northward from Cooks Peak. Lead ore is said to have been discovered in this region in 1876. Jones [15] estimates the total production up to January 1, 1904, at $3,000,000, one-fifth being silver and four-fifths lead. The district is located about 18 miles southwest of Lake Valley and 30 miles, by road, from Deming.

A mass of granodiorite has intruded and uplifted sedimentary rocks of Paleozoic age. These beds are cut by dikes of diorite. The ore-bearing rocks are the Fusselman limestone (Silurian), which is overlain by the Percha shale (Devonian).

The ore consists mainly of lead, with some zinc and silver, occurring as a replacement in the limestone near intrusives. Both oxides and sulphides occur. The ore bodies are very irregular in size and shape, running from small pipes to large pockets 30 to 50 feet in diameter. The ore is thought to have been deposited from hot solutions rising from the granite-diorite porphyry, passing along fractures in the limestone and being intercepted by the overlying shale.

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[15] Jones, F. A., op. cit., p. 181.

The district was active in production 25 to 40 years ago, but in recent years it has become decadent; and at the present time little is being produced. New operations have begun, however, and the outlook is good for the development of a milling grade of ores at greater depths.

Some of the old mines are being reopened. One of these is the Graphic. The Othello group is being operated by the Cooks Milling Co., J. J. Murray, Supt., Deming, N. Mex. These old workings consist of a number of shallow shafts and several miles of tunnels, much of which is now inaccessible because of the former mode of mining; this was, to follow the line of least resistance, gophering out the ore in a very irregular manner. This company has installed a jig and tables for concentration with a very limited amount of water. At the time of visit the company was milling ore from old dumps, which yield about 5 per cent zinc and 10 per cent lead.

Florida station, on the Santa Fe railroad, is 14 miles distant. The road to the mines is very rough for the last 2 miles, while near the station the road is liable to become boggy.

LITTLE FLORIDA DISTRICT

The Little Florida Mountains are about 10 miles southeast of Deming. They lie directly north of the Florida Mountains, from which they are distant about 1 mile.

BLACK ROCK MINE

The Black Rock mine is on the east slope of the Little Florida Mountains, 16 miles southeast of Deming. R. H. West, of Deming, N. Mex., is lessee.

The ore occurs as a fissure vein deposit in rhyolite. The principal ore is the oxide of manganese, which is said to have a value of $18 to $23 per ton. About 1,400 feet of development work has been done, as tunnels and shafts. The ore is concentrated by wet gravity separation. A production of 225 tons per month is reported from this mine, and its future possibilities are considered good.

FLORIDA MOUNTAINS DISTRICT

The Florida Mountains are a conspicuous group, lying about 12 miles southeast of Deming. Their serrated crest presents a rather striking appearance across the plains from the west. The north end contains a large amount of agglomerate, whose erosion has produced the sharply-irregular surface noted. Farther south, Paleozoic limestones form the eastern slopes, reaching in places to the crest of the range—as at Gym Peak. The general upthrow of the faults that cross these mountains is to the south; and in several cases the displacement amounts to 2,000 feet.

Mineral production in the Florida Mountains has not been important. Numerous prospects have been made and several mines have been developed, but no continuous and permanent development has occurred here. The principal ores obtained were silver-bearing galena, and zinc, from the limestone beds, where they occur as replacements. Some copper ore was mined. The copper occurs as the sulphides, in shattered portions of the granite. One of these abandoned lead mines is located on the east side of the Floridas about 17 miles from Deming.

Recent activities in mining in the Florida district are opening up new deposits and are directing attention to some of the old workings. A very favorable prospect has been located on the east side of the range about 22 miles from Deming. This deposit occurs as a replacement in limestone, and in veins. Numerous exposures occur in the vicinity, at different elevations above the level of the desert plains. An almost level road could be had over the bolson valley to the Southern Pacific railroad about 18 miles distant to the northeast. Farther up the side of the mountain, a couple of miles northwest of this prospect, is said to be a zinc deposit of considerable promise.

In the almost uninhabited region of the Florida Mountains there are living a few old-timers who have accumulated a number of mineral claims, which might hold deposits of considerable value. Owing to the financial incompetency of the owners, such claims have not been developed. One such holder of mining properties is Lon English, whose cabin is sequestered at the mouth of a canyon about 20 miles from Deming, on the east side of the Floridas. Mr. English has 23 claims which he believes would be profitable for development. He showed the writer samples of ores taken from these claims, which appeared to carry high values in copper, iron, lead, and zinc.

FLUORSPAR MINES

Fluorite Ridge lies roughly parallel to Cooks Range and southwest of that range about 2 miles distant. In the southern end of this ridge there is a deposit of fluorspar that has been known for some years as a producer. This deposit is 11 miles north of Deming. It is now being worked by the Tortugas Fluorspar Company, of Las Cruces, N. Mex.

The ore is a replacement in veins in a gray monzonite porphyry. These veins dip steeply to the east; as much as 80 degrees. The principal vein is from 3 to 8 feet thick. The fluorite is of a light-green tint, or nearly clear. The country rock is much decomposed along the plane of contact with the vein material.

A shaft follows the dip of the vein to a depth of 220 feet; and considerable stoping has been done along the vein at different levels. The shipping point for this mine is Mirage, a station on the Santa Fe railroad 5 miles southeast. The road is downhill all the way, but is in great need of repair.

Mr. W. D. Howard, of Deming, N. Mex., owns a fluorspar prospect located northwest of Cooks Peak, 33 miles from Deming, and 17 miles from Spalding, a station on the Silver City branch of the Santa Fe railroad. This mine was operated about 30 years ago, and some ore was shipped. Recently the mine has been reopened, and a carload of ore is ready to be hauled to the station.

The vein of fluorspar is reported to be 17 feet thick and outcrops for a distance of 700 feet. The ore body is in granite and limestone, nearly vertical in dip, with a NE.-SW. strike. The ore in the granite is nearly white, and runs about 90 per cent calcium fluoride and 10 per cent silica; the limestone ore is greenish in color and is nearly pure calcium fluoride.

The production of fluorspar in New Mexico began on a commercial scale in 1909, when 710 tons were produced. Up to 1925, the production for the State was 44,000 tons, valued at $525,343. The principal production has been from Luna County, that being the only source of production in the State up to 1917.

TRES HERMANAS DISTRICT

The Tres Hermanas Mountains are about 25 miles south of Deming, near the highway from Deming to Columbus. The group is conspicuous and has received its name from the several distinct sharp peaks that crown its summit.

Mines in this district have been worked many years, but only with a moderate production. The rocks and structure of these mountains are similar to those of the Florida Mountains. A central core of granite porphyry is surrounded by uplifted Carboniferous sediments.

The principal mine has been the Cincinnati, which is said to have produced $100,000. Other prospects have been more or less developed, and some ore has been shipped. In general, the deposits consist mainly of lead and zinc, which occur as contact-metamorphic results in limestone near the intrusive. The prevailing zinc minerals are said to be the silicates and the carbonates. Several prospects are now being developed; among them is that of D. F. Fitzpatrick, of Columbus, N. Mex., located on the east side of the north mountain. Copper and other metals occur here, but little information could be obtained on the extent of the deposit. The ore seems to be associated with metamorphosed limestone and monzonite porphyry.

VICTORIO DISTRICT

The Victorio Mountains are about 22 miles southwest of Deming, just south of the Southern Pacific railroad. This group consists of faulted and tilted Paleozoic limestones overlain on the north by thick flows of andesite. The dip of the main mass of the mountains is toward the north; the southern portion, called Mine Hill, has a southward dip. It is in this southern hill that the Victorio camp is situated.

This camp was productive from 1880 to 1886, and it is said that the total production reached $1,150,000, mainly in lead, carrying silver and gold. The ore occurs in irregular bodies in the limestone. In recent years there has been little production, but efforts have been made to bring this old district back to productivity.

Certain manganese deposits in Luna County have been described by Wells.[17]

MORA COUNTY

Mora County has not produced any metallic ores to the present time and no mining districts have been located. A large part of the county is occupied by the western edge of the Great Plains, which is covered to a considerable extent by lava-flows. The prevailing surface sedimentary rocks are of Cretaceous age. The west end of the county is mountainous, and Truchas Peak, the highest point in New Mexico (13,150 feet), is situated on the boundary line between Mora and Rio Arriba counties. The Mora Mountains extend from Mora northward to the Cimarron Range.

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[17] Wells, E. H., op. cit., pp. 53-55.

TUNGSTEN DEPOSITS

During the summer of 1926, five claims were located west of Mora by J. H. Janzen, Oscar Pickens, and Wallace West, of Springer, N. Mex. Tungsten ores were discovered here by Mr. West some time before. On three of these claims the extension work has been done; these are the Iron Dike, the Red Vandena, and the Black Horse.

The ore occurs as float, on top of the ground, and in fissure veins. It contains values in tungsten, gold, and silver. This property is about 20 miles from the railroad.

OTERO COUNTY

Otero County occupies the middle portion of the State along the Texas border. It comprises an area of 6,870 square miles, which is rather above the average for the counties of the State. A large part of the county is desert, from the barren flatness of which arise certain isolated mountain masses, such as the Jarilla Hills. The eastern portion of the county is occupied by the Guadalupe and Sacramento ranges, which rise to a height of over 9,000 feet. These ranges dip generally eastward, with a bold escarpment to the west. The "White Sands," an anomalous deposit of gypsum, cover a large portion of the western side of the county. Much of the level area was formed as an alluvial deposit, or fill, from material washed down from the surrounding mountains. The log of a deep well 20 miles southwest of Alamogordo revealed 800 feet of fill, below which are alternating red beds and limestone of Permian age.

JARILLA DISTRICT

Otero County has not been very productive of metallic ores. The principal mining district in the past has been the Jarilla Hills. Copper and gold were mined near Orogrande, but there is no present activity in that region.

TULAROSA DISTRICT

The center of the Tularosa district is 13 miles northeast of Tularosa at a little town called Bent. Development began here in 1904, at the Virginia mine. A low-grade copper ore is said to occur here. A mass of diorite porphyry intrudes sedimentary rocks of probably Carboniferous age, resulting in the arching of the sediments and deposition of ore. The ore occurs as a cementing material or dissemination in the sediments, or along joints in the red sandstone; it also occurs in veins in limestone and in the diorite porphyry. Its origin is believed to be in hot upward-moving solutions. There is no production in the district at present.

ALAMOGORDO DISTRICT

While little production of metallic ores has occurred in the vicinity of Alamogordo, some likely prospects have been opened near there. The mine of George Warnock is located on the west front of the mountains 7 or 8 miles east of Alamogordo.

The principal ores are lead and copper, with some silver. The ore occurs in a quartz porphyry. In 1917, copper ore, amounting to 225 tons, was shipped to Pueblo. During the past three years 35 carloads of lead ore were shipped. None has been shipped for a year; but about 1,000 feet of development work has been done, and there is said to be 2,000 or 3,000 tons of ore on the dump. About 30,000 tons of ore have been blocked out. The average of lead value is stated as 8 per cent.

Three miles north of the Warnock property, is a copper prospect—the Courtney—owned by M. M. Massie, of High Rolls. Some ore is said to have been shipped from this prospect.

Several other important minerals are reported from this county. Some lead is said to occur 18 miles southeast of Tularosa. Mica is reported from the San Andres Mountains. Near Weed there is said to be a deposit of diatomaceous earth. In the mountains to the east of Tularosa, titanium ore is said to occur, to the amount of 100,000 tons of 3 per cent material. Mr. J. D. Gwin, of Tularosa, showed the writer a quantity of molybdenum ore, which he claims was mined in the San Andres Mountains.

GYPSUM

Deposits of gypsum of several types occur abundantly in Otero County. One of the most unusual of these is that known as the "White Sands." This deposit covers several townships in the western part of the County. It is a wind-blown deposit of granular gypsum, resembling coarse, white quartz sand. It is perfectly white, so that the drifts look, at a distance, like great snowbanks. Chemical analyses have shown that this sand contains practically no quartz, but is 97 per cent gypsum. The deposit occurs as ordinary dunes, 6 to 30 feet high, which are generally bare of vegetation and are subject to frequent rearrangement by the wind. The eastern edge of the gypsum hills is about 20 miles from Alamogordo.

SODIUM SULPHATE

A deposit of sodium sulphate, of possibly commercial value, is reported from the Tularosa Basin. This deposit, according to a description given out by an association of Alamogordo business men, is located in what is called "Alkali Flats," southwest of Alamogordo, and about 25 miles west of Valmont station, on the Southern Pacific railroad. The Flats are partly in Otero County and partly in Dona Ana County. The area is a structural depression, towards which all the drainage of the surrounding territory is directed. It is generally dry, except after a heavy rain.

The principal deposit occurs in a portion of the area called "Lake Lucero," the remnant of a former much larger lake. The deposit is of considerable depth—said to be 15 to 50 feet, of solid sodium sulphate—and covers an area of 5,120 acres.

The deposit has been known for over 35 years, and several attempts have been made to develop it. At present, it is held under lease from the Government by the association above referred to. It is understood that the present owners desire to turn the property over to some producer who will give assurance of prompt, conservative and adequate exploitation of the deposit.

BENT "ONYX" QUARRY

About 1½ miles south of Bent is the mill of J. A. McAvoy, located near a northward-facing escarpment of red beds and gypsum. Equipment for this plant was about to be installed at the time of visit. It was planned to work and dress the material at the plant.

While this deposit is locally known as "Mexican onyx," the material is not Mexican onyx, but a massive type of gypsum that might be called alabaster. It is a very attractive-looking stone, occurring in two colors—a gray and a white or yellowish-white. There seem to be extensive deposits of this material in the vicinity.

MARBLE

The marble quarry of the Alamoro Marble Company (lessee) is located 3 miles east of Alamogordo. Frank Falcone, of Alamogordo, N. Mex., is owner. The quarry is situated along the north wall of a canyon, on the west slope of the Sacramento Mountains. There is a good road and down grade from the quarry to the railroad. The quarry was opened in 1899, and has been producing marble since that time. The work of quarrying was suspended at the time of visit, but a large amount of rough stone was ready for use.

The quality of this stone is excellent; it is light gray in color, and takes a high polish. At least 560,000,000 cubic feet of stone is in sight, all of good quality. This marble has been shipped in the rough to 17 different States, and Mr. Falcone maintains a monument shop near the quarry, where the stone is dressed and polished.

RIO ARRIBA COUNTY

Rio Arriba County embraces a portion of the plateau province, in its western part, while its eastern end lies within the area of the Rocky Mountains. The western part, like that of Sandoval County, is covered by rather flat-lying sediments of Cretaceous age and Tertiary. These contain extensive coal beds, but no metallic minerals of consequence. The eastern part contains metallic ores, as well as important deposits of mica and other non-metallic materials. The southern part of the county is covered by Tertiary deposits or by rhyolitic and basaltic lavas. The Chama has cut into the Cretaceous rocks and the Triassic red beds for a considerable part of its course. The northeastern portion of the county contains a large area of pre-Cambrian rocks—gneisses and schists. The east boundary line in general marks the division between the pre-Cambrian area to the west and the wide basaltic flows extending to the central part of Taos County. The western part of the county lies across the Continental Divide, whence drainage on the west is into the San Juan River. The Chama River flows through the central part, emptying into the Rio Grande a few miles above Espanola. The eastern portion of the county drains more directly into the Rio Grande.

HOPEWELL AND BROMIDE DISTRICTS

The Hopewell district lies along the Continental Divide east of Tierra Amarilla. The old mining camp of Hopewell is about 15 miles due east of Tierra Amarilla. The Bromide district adjoins the Hopewell district on the east, with Tusas as its post office. The nearest railroad station is Tres Piedras, on the Denver and Rio Grande railroad, about 12 miles southeast of Tusas. According to Jones,[18] the first claim in the Bromide district was located in 1881, and discoveries of gold were made near Hopewell in the same year.

GEOLOGY

The prevailing rocks of the district are gneisses, schists, quartzites, and granites. Between Tusas Creek and Tres Piedras is a ridge composed largely of coarse conglomeratic material, largely igneous, loosely cemented. West of Tusas Creek the rocks seem to be prevailingly gneissic and schistose. The Tres Piedras (three rocks), and other exposures of the same formation, seem to be of a much-weathered granitoid gneiss. The predominant rock at Hopewell seems to be reddish-to-gray micaceous schist; there is also a greenish garnetiferous schist.

ORE DEPOSITS

The principal ore of the Hopewell district is gold, while the Bromide district contains mainly copper and silver. The ores occur in veins in the metamorphic rocks or in granite intrusions into the metamorphic series. The primary deposits are of two types—quartz veins and disseminations of pyrite in schists. The quartz contains several minerals, the most important of which is pyrite, which carries the gold. The gold is said to follow the main vein deposit and does not occur so abundantly in the pyrite occupying the outlying portions of the vein. In the Bromide district the pyrite is less, and the chalcopyrite more, abundant, with a less value in gold and an increasing value in copper and silver. The general mode of occurrence of ore in the two districts is the same.

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[18] Jones, F. A., op. cit., pp. 163, 165.

The gold does not occur free except in the oxidized zone and in placer deposits. The oxidized zone reaches about to the groundwater level, which is 50 to 100 feet below the surface. The ore veins and the disseminations are not conspicuous as outcrops, thus making them difficult to trace. The ore values vary widely, some being too low-grade to pay for working; but some as high as $800 per ton, in gold.

In addition to the deposits occurring in the bed rock, there were some placer gold deposits in the Hopewell district. Placer gold to the value of $250,000 or $300,000 is said to have been taken from one area on Eureka Creek.

DEVELOPMENT

These districts were never extensively developed. More than a score of prospects were developed to some extent, but only a few of these have produced commercially. The placer deposits of the Hopewell district have yielded the major part of the total production for the two districts. The principal producing mine in the Bromide district was the Bromide, the first location in the region.

BROMIDE MINE

The Bromide mine is located on Spring Creek, 14 miles from the railroad at Tres Piedras and about 2 miles southwest of Tusas Peaks. This mine was owned by A. B. Renahan, of Santa Fe, N. Mex. The production is said to have been $60,000, mostly in silver chloride and copper sulphides.

MINERAL POINT CLAIM, CROESUS, BEN HUR, ETC.

These claims—Mineral Point, Croesus, and Ben Hur, with six other lode claims—are owned by the estates of E. S. Page, Mary E. Steel, Hope, G. P. Rusten, and Edwin P.

Seward, of Tres Piedras, N. Mex. These claims are located on the west side of Eureka Gulch.

The ore is disseminated through the schist, with here and there lenses and pockets of richer ore. The ore has values of $2.50 to $100 per ton. It is free-milling. The total production from these properties is estimated at $25,000.

The future possibilities are considered "splendid." Formerly the camp was rather inaccessible on account of poor roads, distance from railroad, etc., but in late years many of the difficulties of marketing the ore have been removed. The region is well watered and timbered.

HOPEWELL-FLAT PLACERS

Gold placer claims on Eureka Creek, near Hopewell, are owned by J. P. Rinker and Edwin B. Seward, of Tres Piedras, N. Mex. There are accessible 60 acres of gravel and 40 acres of dumping ground. A hydraulic plant was installed and a ground sluice built, which awaits an expenditure of a small amount of capital to start work. Eureka Gulch above this placer was worked for a number of years for placer gold, with a production as above indicated.

The present property was put into shape for work by a Boston company, as a side issue to some other mining property in Colorado. The latter undertaking proving a complete failure, this property was abandoned without a test run ever having been made. These claims are 22 miles from the railroad.

ABIQUIU MINES

Copper deposits about 9 miles north of Abiquiu are said to have been worked by the early Spanish explorers. According to Newberry,[19] the copper occurs at the base of a yellow sandstone overlying red marls. The ore is distributed through a layer 4 or 5 feet thick, and occurs as a sulphide of copper and iron and as malachite replacing trunks of trees and in botryoidal masses scattered among pebbles of quartz. The property was owned by the father of J. P. Gonzales, of Abiquiu, N. Mex.

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[19] Newberry, J. S., quoted in Prof. Paper 68, p. 149.

MICA DEPOSITS

The largest and most important area of mica known in New Mexico is situated in the eastern end of Rio Arriba County. Here is an area of pre-Cambrian rocks—gneisses, schists, etc.—traversed by pegmatite dikes, which are productive of not only mica, in enormous quantities, but also of many rare minerals. The area of mica-bearing dikes is at least 10 miles long and 3 miles wide, extending from near Ojo Caliente northward to the vicinity of Las Tablas; 8 to 15 miles west of the Denver and Rio Grande railroad.

These deposits were examined by Holmes,[20] in 1898, and by Sterrett,[21] in 1911. Holmes writes as follows: "At the Cribbenville mine, the best known of them all, a considerable amount of work was done between 1884 and 1889 . . . The larger part of the mica found in the Cribbenville district is of good color and is free of iron specks; but the proportion of merchantable sheet mica is greatly decreased by the ruling." The Cribben mine is about 2 miles southwest of Petaca. Holmes mentions more than a dozen mines that were producing to a small extent. Many of these workings are not now producing and probably would not be recognized by name. Other mines have been opened in recent years, and production is increasing. The mica is of the muscovite variety. The region has been worked for mica in only a desultory way until the past few years, but the present prospects for a large development of the industry here are exceedingly good.

Other minerals reported as occurring in more or less abundance in the region are cyanite, talc, bismuth, manganese, beryl, columbite, samarskite, scheelite, silver, copper, and gold.

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[20] Holmes, J. A., 20th Ann. Rept., U. S. Geol. Survey, Pt. 6, pp. 706-707, 1899

[21] Sterrett, D. B., U. S. Geol. Survey Bull. 530, pp. 383-388. 1911.

PETACA AREA

The Lobato mine, owned by Edwin B. Seward, of Tres Piedras, N. Mex., is located near Las Tablas. A good quality of plate mica is found here; also samarskite is said to occur associated with the mica. A shaft and tunnel have been opened for 60 feet. This prospect is 11 miles from the railroad.

Robert Sudduth, of Tres Piedras, is opening a mine 2 miles west of Petaca, 13 miles from the railroad. A small amount of mica has been produced, but none is now being marketed. The ore occurs in pegmatite in schist. An inclined tunnel has followed the vein for 150 feet, and some excellent sheet mica has been taken out, with a considerable proportion of the lined and fish-tailed grade. The owner has great faith in the possibilities of this deposit and deplores the absence of capital to exploit it. He issued the following statement to the writer: "Any man who wants to put a little money in here, and put it in right, I will guarantee a 15 per cent dividend the first year and back it up with a $10,000 property."

BROMIDE AREA

H. W. Palmer, of Tres Piedras, N. Mex., owns a claim on Kiowa Mountain, known as the Mica Queen. There are many different veins. Prospecting has been done largely by quarrying, and work has gone on in a desultory manner for three years. The prospects for this property are considered good. It is 10 miles from the railroad.

LAS TABLAS AREA

The Hoyt Mineral Corporation is operating the Las Tablas mine, located about 1 mile from Las Tablas. The deposit is described as an immense stockwork of pegmatites carrying mica and rare minerals. There is one tunnel 50 feet long, four shafts, and one deep shaft now being sunk to test the pegmatite to the bottom of the mica formation. About two tons per day, of mine run, is being produced. The mine is 9 miles from the railroad; one of the drawbacks to production is the bad condition of roads, there being no co-operation by state, county or citizens.

FLUORSPAR

A deposit of fluorspar of possible economic importance is being developed by the Mines and Minerals Corporation, 3 miles northeast of La Madera, J. G. Parkin, superintendent. The ore outcrops on a ridge 600 feet above the bottom of the gulch. The fluorite occurs as an encrustation around pebbles and in crevices of a coarse rhyolite conglomerate, apparently just above the surface of a mass of rhyolite. The deposit seems to follow a vein, nearly vertical in position and striking about north and south. At the time of visit a tunnel was being driven into the mountain to tap the vein about on the level of the bottom of the gulch. The tunnel had been carried in 500 feet, and it was supposed the vein would be struck about 100 feet farther.

SANDOVAL COUNTY

The western and southern portions of Sandoval County lie within the plateau province and are covered, for the most part, with Cretaceous sediments. These sedimentary deposits are nearly horizontal or have gentle dips away from major uplifts. They are frequently considerably faulted. Older formations outcrop around the Nacimiento uplift, against which they are steeply inclined. From the center of the county northward, the surface is occupied by the Nacimiento Mountains, a granite mass some 10,000 feet high, more or less overlain and surrounded by sedimentary formations as late as the Cretaceous. The northeastern portion is covered with rhyolitic and basaltic flows, which culminate in the Valles Mountains, 12,000 feet high.

The county is drained by the Rio Grande in the east and the Rio Puerco in the western part; this stream also enters the Rio Grande farther south, in Socorro County.

The county contains large areas of coal and thick gypsum deposits. There are numerous mineral springs in the mountainous portions, as at Jemez Springs. Metallic ores are found in several parts of the county.

NACIMIENTO DISTRICT

The Nacimiento Mountains comprise a core of pre-Cambrian granitic and metamorphic rocks, with the surrounding upturned edges of sediments of Pennsylvanian to Cretaceous age. To the west, these upturned strata flatten out to nearly a horizontal position within 2 or 3 miles. To the east, the sedimentary series are less noticeable, being covered by thick deposits of extrusive rocks reaching from the Valles Mountains in every direction; so that the sedimentary rocks are brought to the surface only, or mainly, where erosion has cut through the igneous flows. The Nacimiento range extends north and south a distance of about 50 miles.

The Nacimiento mining district embraces an area about 12 miles north and south, and 3 miles east and west, near the center of the range and on its western slope. Its northern limit is opposite Cuba and about 4 miles east of that village. Until recently, the nearest railroad station was Bernalillo, a station on the main line of the Santa Fe railroad, about 75 miles from the northern part of the district. At the present time the Cuba Extension railroad, from San Ysidro to Cuba, has already been constructed a distance of 11 miles; or 38 miles from Bernalillo.

The two most important localities in this district have been the vicinity of Eureka mine, in the northern part of the district, and the San Miguel mine, about 10 miles farther south.

The district has been a small copper producer, and is said to have been known by the Indians as early as the middle of the nineteenth century. Some mining was being done in 1884 and activity continued for several years, but the mines have been idle for some time.

EUREKA MINE

The Eureka mine is situated in the northern part of the district, about 10 miles east of Cuba, at an elevation of 9,000 feet. It is near the crest of the range, on the west side, and is difficult of access, being 400 feet above the highway and on the side of a steep, rocky canyon.

GEOLOGY

The copper deposits of the Nacimiento district are, according to Schrader,[22] in the Red Beds formation. Schrader quotes from Newberry as referring these copper deposits to the Triassic. The red formation extends over the crest of the mountains here, where the highway crosses the ridge. Considerable displacement has occurred in the formations on the west side of the mountains, making it difficult to correlate the sedimentary rocks. At the Eureka mine, the dip is to the southwest. While the immediate sedimentary rocks at the Eureka mine are not red sandstones, it is said that some 300 feet of red sandstones lie between the cupriferous beds and the underlying granite. The presence of replaced fragments of wood found in some of the ore deposits tends to confirm the belief that the formation is of Triassic age.

ORE DEPOSITS

The principal ore mineral appearing in the workings of the Eureka mine is malachite. This mineral occurs in a coarse conglomerate about 4 feet thick. The conglomerate overlies a soft white sandstone, sometimes variegated with brown. The ore appears to form the cementing material of the conglomerate. In some places the ore is deposited in crevices leading out from the main ore body or along the bedding planes of the formation. Above the ore bed is a yellowish-gray sandstone to the top of the escarpment, some 50 feet higher.

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[22] Schrader, F. C., Prof. Paper 68, p. 113.

Considerable development work has been done here. The main tunnel follows the bedding of the ore body for several hundred feet. The ore does not indicate a very rich deposit, and it is doubtful if mining could be carried on with profit.

COPPER GLANCE MINE

About 4 miles down the canyon from the Eureka mine and half a mile from the highway is located the Copper Glance mine. Here the general formation is similar to that at the Eureka mine. The ore consists mainly of chalcocite, occurring as a replacement of carbonaceous matter buried in a coarse white sandstone. Bits of replaced logs and twigs are scattered through the sandstone. The ore also follows the bedding of the rocks. The thickness of the metalliferous portion of the sandstone is about 50 feet. The beds dip 25 degrees SW., at the entrance of the main tunnel.

The tunnel extends into the side of the mountain a distance of 400 feet, the first 300 feet being through a white sandstone. Beyond this is a light-brown sandstone. The ore occurs mainly within 100 feet of the adit of the tunnel, beyond which there is no ore, either in the white sandstone or the brown.

The production of the mine is said to have reached 920 tons of ore in 1886-87, which yielded 677,120 pounds of metallic copper. The present appearance of the ore body would suggest a much lower percentage of copper per ton of ore.

SAN MIGUEL MINE

The San Miguel Mine is about 9 miles south of the Copper Glance. The age and structure of the formations are similar to those in the northern part of the district. This mine was not visited by the writer, and it was understood that the mine was not producing in 1926. This mine was first opened in 1884. The ore is said to occur as chalcocite in fossil remains of wood. The ore was of a higher grade than that of the northern part of the district, but the main body of ore seems to have been worked out. This mine is credited with the major portion of the production of the Nacimiento district. About 2,500 tons of metallic copper have come from this mine.

GALLINA DISTRICT

Farther north on the Nacimiento range and around its northern end, occur other copper deposits, in what is called the Gallina district. This region is less well known than the Nacimiento district. The formations are said to be similar in many respects to those of the Nacimiento district, and the ores are similar and occur in much the same mode as do those of the district farther south. No production has occurred from this district.

JEMEZ SPRINGS DISTRICT

About 3 miles south of Jemez Springs is located the Spanish Queen mine, now under lease by the Burnett Mining Company, Inc. Ruins of an old Spanish smelter still may be seen near the mine. The mine was recently opened up, and work is going forward for the installation of a smelting furnace on the property.

The ore deposit is of the blanket type, the ore occurring in seams and along the bedding planes of sandstone and shale. These sediments outcrop just above the highway, on the east side of Jemez Canyon, and dip gently eastward. The formation is supposed to be of the same age as those of the Nacimiento district.

The ore consists of chalcocite, with some carbonate ores, carrying copper values of \$12 to \$171 per ton; silver, \$2.50 to \$5; and a small amount of gold. The ore body is 2½ feet thick and about 125 feet wide.

The workings consist of 700 feet of drifts, in the mountain side directly on the vein, and considerable stoping. With the installation of the furnace, the ore will be reduced to a 95 to 97 per cent black copper matte. The mine is 4½ miles from the branch of the Santa Fe and Northern, running to the San Diego Grant. The prospects are considered encouraging for a profitable development of the property.

COCHITI (BLAND) DISTRICT

The Bland district is situated on the southeast slope of the Jemez Mountains. Cochiti, an Indian village on the west side of the Rio Grande, is 35 miles by road from Bernalillo. The old camp of Bland is 14 miles northwest of Cochiti, in the mountains, toward the head of Pino Canyon. Bland is 44 miles from Santa Fe by road. This is one of the most remote mining districts in the State. The camp of Bland, now almost deserted, in 1899 had a population of 400; while the adjoining camp of Albemarle employed an equal number of men.

TOPOGRAPHY

The country west of the Rio Grande rises rather abruptly from the river valley to a gently eastward-sloping mesa trenched with many canyons and water courses. The mesa is built up largely of rhyolitic tuff, or fragmental material, washed from the adjacent mountains. About 8 miles from the river the gently-rising surface of the mesa gives way to the outer escarpments of thick flows of rhyolite, which make up much of the mountainous portion of the district. Pino Canyon and other canyons here lead into the rhyolite-covered area, between precipitous walls of rhyolite 700 to 1,000 feet high.

GEOLOGY

The oldest rocks exposed are impure sandstones, supposed to be of Cretaceous age. It is only in certain places that these rocks are observable. Underlying the sandstones and evidently intruded into them, is a mass of igneous rocks —monzonite, monzonite porphyry, and diorite porphyry. These two systems of rock had suffered much erosion, when they were covered deeply by flows of rhyolite. This extrusive is the most conspicuous rock of the region, as it is found, in one type or another, over most of the surface from Guadalupe Canyon and Jemez River to the Rio Grande. A succession of rhyolitic flows, probably emanating from the region of Pelado Peak, 12 miles northwest of Bland, spread over the eroded surface, filling the old canyons and leaving a gently-sloping plain surrounding the volcanic vent for a distance of 10 to 25 miles. Subsequent erosion has trenched this plain with deep, narrow canyons, often exposing the underlying formations.

The rhyolite has a great variety of types, varying in color and structure. The colors range from a streaked reddish and black to pink and light gray. The structure in some cases is massive and compact; in others, porous and almost pumiceous. Brecciated phases occur extensively, as if the partly-solidified flow had been disturbed and worked over by oncoming flows of magma or hot muds, leaving fragments of the former cemented in a matrix of the later rock.

ORES

The ores of the Cochiti district consist principally of gold and silver, in relative values of 3 to 1. The ores occur in the monzonite porphyry, in fissure zones as vein deposits, and as replacements in the wall rock or fractured portions thereof. The principal gangue is quartz, while pyrite and sphalerite occur in small amounts. The ore is not free-milling; the silver is a bromide. The ores run in values from $12 to $15 per ton. The fissures do not extend up into the rhyolite, and it is supposed that the ores were deposited before the extrusions of rhyolite.

DEVELOPMENT

Mining in this district had become very active by 1893. In 1894 the Albemarle group of mines was located, and active mining continued for about 10 years, during which time the district produced over $1,000,000. When the camp opened up, in 1893, it was boomed in the *Rocky Mountain News* as a second Cripple Creek. At present time no production is being made, although some development work is being done. The Crown Point Development Company has charge of 14 patented and 7 unpatented claims.

The most important mine in the district was the Albemarle. This is located on the west fork of Colla Canyon. The mine is said to have an incline shaft 625 feet deep, and perhaps 5,000 feet of drifts. According to Art Knaebel, local miner still living at Bland, the ore occurs in an andesite or andesite porphyry. A cyanide extraction plant, costing $1,500,000, was operated for a number of years after 1899. The production of this mine is estimated at $800,000.

The Crown Point, the Lone Star, and the Washington produced, it is estimated, $300,000. The Iron King is said to have yielded $50,000.

GYPSUM

Gypsum deposits of considerable extent occur south and west of the Nacimiento Mountains, where formations of late Paleozoic and Mesozoic age are upturned and eroded. These deposits are within easy access to the Cuba Extension railroad between San Ysidro and Cuba.

MINERAL SPRINGS

Numerous hot springs and gaseous emanations occur in the northern part of the county, whose waters contain various minerals in solution. The most common type of deposit from such waters is calcareous tufa, a form of calcite. This calcareous deposit accumulates around the springs, often forming huge mounds with immense cauldrons in the center (The water continually running over the sides has left its deposits, which build the rim higher and higher). The so-called "Soda Dam" at Jemez Springs is a deposit of this nature. So, also, are certain deposits along the south and west sides of the Nacimiento Mountains, from San Ysidro northward for 12 or 15 miles.

About 13 miles north of Jemez Springs an area of several acres is subject to fumarole activity. Hot sulphurous vapors issue from the ground, depositing free sulphur on cooling. Some years ago attempt was made to prepare sulphur on a commercial scale, from these deposits, but without success. The dismantled mill still stands. The springs of sulphurous water and the vaporous exhalations are utilized to some extent in a medicinal way at the present time, but no effort has been made recently to utilize the accumulations of sulphur.

An interesting scientific result, as well as an economic problem of some importance, has followed the drilling of a deep well on the west side of the Nacimiento Mountains, 13 miles from San Ysidro, on the Cuba road. Here was struck an immense flow of hot, mineralized water at a depth of about 400 feet. At a depth of over 2,000 feet the flow continued and the temperature of the water had increased to 142° Fahr. The water is highly saline and the high mineral content rapidly corrodes the casing of the well, making a difficult problem to control the well.

The source of the hot water has not been determined, though theories have been advanced to explain the conditions. It is quite likely that this water is of the same origin as that which formed the spring deposits farther up on the side of the mountains to the east of the well. The heat may be due to the presence of hot igneous rocks relatively near the surface. The water is possibly meteoric, having passed downward to the zone of heated rocks, thence moving outward by hydrostatic pressure.

SAN MIGUEL COUNTY

San Miguel County is similar to Mora County in general topographic and geologic conditions. The major portion lies in the Great Plains border, while the western part rises to the broadly uplifted sedimentary formations and pre-Cambrian core of the Las Vegas Range. The structural arrangement of the mountains in this region is very complicated. But in general there seems to be a north and south fault, which has brought up the pre-Cambrian core and tilted the sediments eastward, forming the Las Vegas Range and the Pecos Valley to the west of it.

PECOS MINE[23]

Metal mining on the Pecos River 13 miles north of Pecos town and 15 miles east of Santa Fe began about 1882, at what used to be called the Hamilton mine. This mine was operated at first for the production of copper, and considerable development work was done in later years, but it did not reach a commercial production. In 1925 this property was acquired by the American Metal Company of New Mexico, and it has since been extensively developed.

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[23] From a discussion by A. H. Hubbell in Eng. and Min. Jour., Dec. 25, 1926.

GEOLOGY

The mine is located near the south end of an exposure of pre-Cambrian rocks near the bottom of the valley of Pecos River, at an elevation of 8,000 feet. The country rock is a granite gneiss cut by diorite dikes. Both of these were intruded by a hornblende granite; this intrusion was followed closely by an intrusion of acid and basic dikes. After the intrusions the region was shattered by great vertical movements, which developed a shear zone nearly 1,000 feet wide and several miles long. The displacement took place parallel to the general direction of the intrusions, the strike being N. 45 degrees E. The shattered zone provided channels for the upward movement of hot mineralizing solutions, the effect of which was to alter the igneous rocks into bands of schists. After the development of these schists, there were deposited high-temperature minerals—such as tourmaline, quartz, actinolite, biotite, gold, copper, and pyrite. Still later came deposits of lead, zinc, and pyrite, with little quartz. A second set of movements, mainly horizontal, followed the mineralization. Upon the oxidized and eroded surface of this basement of pre-Cambrian rocks, were deposited sandstones and limestones of Pennsylvanian time.

ORES

The main ore body occupies from 4 to 40 feet in width of the shear zone and dips nearly to the vertical. The ore occurs in lenses along the fissures, usually in the schists; but also in granite phases and in diorite when schistosity is absent. No ore occurs in the overlying sediments. Secondary enrichment is of little importance here. The ore consists of the sulphides of zinc, lead, and copper, with a little silver and gold.

DEVELOPMENT

The mining company is establishing a \$2,000,000 plant and is planning for a 5-year operation. It is expected that 1,000,000 tons of ore are available, averaging 17 per cent zinc, 5 per cent lead, 1 per cent copper, 3.5 ounces silver, and 0.13 ounce gold. A 600-ton differential flotation mill is being erected at Alamitos station, 4½ miles from Fox, on the Santa Fe railroad. A 12-mile aerial tramway will connect the mine with the mill. The concentration will be 2½ or 3 to 1, the concentrates averaging about 52 per cent zinc, 0.8 per cent lead, 2.08 per cent copper, 7 per cent iron, 3.86 ounces silver, and 0.14 ounce gold.

ROCIADA DISTRICT

The Rociada district is in the northwestern part of San Miguel County, near the Mora County line. Copper occurs in the pre-Cambrian rocks along the east side of Las Vegas Range, contiguous to Carboniferous sediments where they have been brought down against the pre-Cambrian by faulting. The ore occurs in fissure veins in schists and gneissess. Several prospects were opened at Rociada and Hadley in about 1900, but they have made no commercial production.

TECOLOTE DISTRICT

The Tecolote district of San Miguel County is of rather indefinite extent, since it comprises a number of widely scattered prospects in the western part of the county, west and southwest of Tecolote Mountain. The mineral deposits are mainly copper, which occurs in sedimentary rock.

The ores in some cases are found in an arkose sandstone of the top of the Carboniferous system, just below red beds; and in other cases are in a white arkose lying just above the red beds. This white arkose is supposed to be Dakota. The ore consists of sulphides disseminated through the beds, or as malachite, more closely confined to certain narrow beds in the sandstone. The ores are of low grade and the district has not produced an important amount of copper.

SANTA FE COUNTY

The northern part of Santa Fe County is a much-eroded plain of Tertiary deposits shut in on the east by the Santa Fe Range and on the west by the extensive rhyolitic and basaltic flows of the Valles Mountains. The southern part of the county is mainly a plain, stretching southward to the Estancia Valley. The drainage is by the Rio Grande and the Galisteo Creek, which joins the Rio Grande near Domingo. Near the west line are several elevations formed by intrusions into, and uplift of, the sedimentary series—such as the Cerrillos Hills, the Ortiz, the San Pedro, and South mountains—lying somewhat in a north and south line.

The most important mineral resource of the county is the coal, of the Madrid mines. Other non-metallic deposits are gypsum, turquoise, volcanic dust, mica, and clay. The metallic resources include lead, zinc, copper, and gold.

CERRILLOS DISTRICT

The Cerrillos district consists essentially of a group of low igneous hills lying just north of the station of Los Cerrillos and about 18 miles southwest of Santa Fe. The district is noted especially for the deposits of turquoise, which were early mined by the Spanish explorers. Lead, silver and zinc occur.

GEOLOGY

The hills consist of a grayish, granular rock resembling monzonite porphyry. Johnson[24] calls it an augite andesite but Lindgren is inclined to class it as a monzonite. These igneous masses have evidently intruded and domed up the overlying sedimentary rocks, which were later removed by erosion. The intrusive mass is surrounded by the upturned edges of such sedimentary rocks; these rocks are of Cretaceous age.

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[24] Johnson, D. W., School of Mines Quarterly, Vol. 25.

MINERAL DEPOSITS

The principal metallic ores are lead and zinc, and there are small values of gold and silver. The mines were worked in an early day, but there seems to be no record of the first discovery of ore in the district. In 1879 the district was rediscovered, and it was soon opened up. A few hundred thousand dollars in silver and lead have probably been taken from these mines.

The ores occur, for the most part, along shear zones in the monzonite porphyry. This zone has a steep dip and a strike northeast; the veins are small but numerous. The prevailing ores are silver-bearing galena, sphalerite, and a little chalcopyrite.

CASH ENTRY MINE

The Cash Entry mine is the best known of any in the district and is one of the oldest. It is located 3 miles north of Cerrillos. The shaft is 650 feet deep, and there are supposed to be 5,000 feet of workings. The groundwater level is 150 below the surface, and this practically coincides with the present top of the sulphide zone. Considerable zinc carbonate was found above this level. This mine has not been in operation for many years.

TOM PAINE MINE

The Tom Paine mine is located on the north side of the hills, about 4 miles north of Waldo, on the Santa Fe railroad. This is an old mine, it having been operated, with more or less success, for nearly 50 years. The mine is owned by G. L. Brooks, of Albuquerque, N. Mex.

The ore occurs as a replacement along fissure veins in monzonite porphyry. The ore body averages 10 feet wide, with a pay-streak about 2 feet wide. The ores are mainly the sulphides of lead and zinc, the galena carrying a small amount of silver. The values of ore per ton are, in silver, 3 ounces; in lead, 7 per cent; and in zinc, 15 per cent.

During the World War the mine produced 3,500 tons of ore, but since then there has been no production, except in 1926, when 50 tons were produced. About 1,300 feet of development has been done. The possibilities for future development are said to be extensive.

FRANKLIN COPPER GROUP

The Franklin copper group is located half a mile northeast of the Tom Paine mine; it is owned by W. H. Paul and Alex Matthiessen, of Cerrillos, N. Mex. The geology and mode of occurrence of the ore are of the same general nature as at the Tom Paine mine. The ore occupies a chimney in the intrusive and is of the oxidized zone. The mineralized section is about 50 feet in diameter. The ore values per ton are copper, 3 per cent and gold, $5.

Development is by open cut, mainly; there is also a shaft 100 feet deep and drifts on three levels. The ore is now being mined from a large open cut, at the rate of 100 tons per week. There is blocked out 20,000 tons. The ore is sent to El Paso smelters, without concentration. The haul to the railroad is easy, a distance of 5½ miles.

TURQUOISE

The district is famous for the turquoise mines, which have been worked for centuries. There are two deposits of turquoise in the region—one near the center of the hills and the other about half a mile east of the old highway, 5 or 6 miles north of Cerrillos. The latter deposit is in a cluster of bare, low hills, whose surface is burrowed and roughened by the many excavations made in the search for the mineral. Some of the old shafts and tunnels are supposed to have been made by the early Spanish explorers, or by the Indians. The turquoise occurs in a much-disintegrated monzonite porphyry, as a filling of crevices and small openings. The mines have not been systematically worked for several years.

DOLORES, OR OLD PLACERS, DISTRICT

The Dolores district embraces the Ortiz Mountains, a laccolithic intrusion of diorite or monzonite porphyry rising to a height of 8,928 feet, located about 7 miles south of Cerrillos. It is probably similar in origin to the Cerrillos Hills and San Pedro Mountains. The covering rocks have been eroded away, leaving their upturned edges around the base of the mountains. These sediments are exposed in some places; in other places they are covered by talus from the mountains. They are of Cretaceous age.

ORE DEPOSITS

The district is noted as being the oldest gold-mining locality in the State. It is best known by its placer deposits, which were discovered and worked as early as 1828. It is supposed that nearly $2,000,000 in gold was taken out. No active mining has been done for many years.

The placers are on the east side of the mountains, where was located the mining camp of Dolores, now deserted except for the warden of the mines. The deposits are the accumulated debris washed down from the mountains. Some distance from the mountains the depth of the deposits is said to be over 100 feet. It is probable that much good gravel remains, but the scarcity of water is a permanent hindrance to effective mining.

Lode mining was carried on to some extent in Cunningham Canyon above Dolores. This vein occurs in a breccia of porphyry. The deposit was discovered in 1833, and became known as the Ortiz mine. The richest ore shoots are said to occur above the level of groundwater, which is 150 feet from the top. Some gold is said to have been taken from a metamorphosed bed of limestone on the side of the mountains toward Golden.

SAN PEDRO, OR NEW PLACERS, DISTRICT[25]

The San Pedro Mountains are about 3 miles south of the Ortiz, and are of the same general type of laccolithic uplift. Here, however, rocks older than the Cretaceous are exposed around the uplift. Carboniferous limestones still remain on top of the mountains or reach far up on the slopes. The main intrusive is called a "granodiorite" porphyry. Dikes of monzonite porphyry cut both the intrusive and the sedimentary rocks. In some places the limestones are metamorphosed into a bluish, variegated marble.

ORE DEPOSITS

The important metallic ores found in the San Pedro district are copper, gold, lead, and zinc. All of these are related to the porphyry intrusive, either as products of contact-metamorphism or as veins emanating from the hot porphyry mass. All of these metals have been produced in commercial quantities, but the mining industry in the district has gone through many vicissitudes.

GOLD PLACERS

Gold occurs both as placer and as vein deposits. Placer gold was discovered near Golden in 1839. An area of gravel comprising at least 1 square mile lies eastward from Golden and towards Las Vegas Canyon, leading from the north side of San Pedro Mountains. Attempts were made many years ago to recover gold from this deposit by dredging. A placer mine at the mouth of Las Vegas Canyon, owned by the Wood family, was operated by a dredge until the death of Colonel Wood, in 1918. Work was then shut down, and the dredge has not been in operation since. The success of these operations was much hindered by the scarcity of water. Water from artesian wells has been used to augment the meager surface supply.

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[25] Yung, M. B., and McCaffery, R. S., The ore-deposits of the San Pedro district, N. Mex.: Trans. Amer. Inst. Min. Engrs. Vol. 33, pp. 350-362, 1903.

Preparations have been recently undertaken by J. Jason Jones, of Golden, for operating a dredge and concentrating system near the site of former operations at the mouth of Las Vegas Canyon. About $400,000 in equipment has been installed and it is expected that work will start in full force as soon as the weather permits in the spring of 1927.

LODE DEPOSITS

Vein deposits occur toward the west end of the San Pedro uplift. The porphyry is traversed by numerous fractures, along some of which displacement has occurred. Many of these planes of fracture have been mineralized, so that veins 1 inch to 3 feet in thickness occur. Calcite and quartz occur as gangue, and pyrite is the main metallic mineral; it probably carries the gold. Oxidation has changed the content of these veins near the surface, leaving the gold free. The occurrence of ore is very erratic, in some places rich pockets being found, while many feet of the vein are practically free of gold. The production of certain claims on these veins is thought by some to be able to be brought to commercial importance. None of the mines, however, are at present producing.

ARGO MINE

The Argo Mining and Milling Company, 1101 Sherman Boulevard, Milwaukee, Wisconsin, owns 8 claims in Las Vegas Canyon, 1½ miles southeast of Golden and 8 miles from the railroad at Hagan. The ore occurs as free gold, in fissure veins in porphyry, and the assay value is said to be from $10 to $100,000 per ton. The development consists of a shaft 130 feet deep and about 600 feet of tunnels. It is claimed that 500 tons of ore averaging $48 per ton is on hand, and it is expected that operations will begin in 1927.

COPPER DEPOSITS

San Pedro district was an active producer of copper 20 or more years ago. At present there is practically no production, and the dismantled ruins of the old smelters and abandoned tunnels remain as evidence of former operations. For 47 years, from 1871, copper was mined and smelted on the southwest slope of San Pedro Mountains. In 1918 the smelter was burned, and it was never rebuilt, as the mines were thought to have been practically worked out. From 1889 to 1892 it is said that several million pounds of copper were produced. Work was started several times after that, but lowering prices of copper always forced a shut-down of the mines.

The chief copper ore is chalcopyrite, and there is said to be a large amount of lowgrade ore, averaging about 2 per cent copper and 80 cents per ton in gold and silver. The main area of copper deposition is on the south slope of the western end of the mountains, and the deposits occur at the contact of the porphyry with the overlying sedimentary beds.

LINCOLN-LUCKY MINE

LEAD AND ZINC

The principal producer of lead and zinc has been the Lincoln-Lucky mine, located about 1 mile east of San Pedro village, on the south slope of the mountains, near the site of the old copper smelter. The mine was opened many years ago and some of the older workings are now partly caved in. For a number of years the mine had been abandoned, but recently operations have been actively carried on by the Collier Mines Company. This company has brought the mine to a successful and paying condition, however, under the persistent and intelligent management of E. J. Jenkins.

The ore occurs in Carboniferous limestone that has been upheaved by the intrusive porphyry and that lies well up on the south side of the mountain. The rocks dip SE. 8°. The ore body follows the bedding of the formation and is a replacement in the limestone. The ore body is 20 by 5 feet in cross-section and the walls are very irregular. Oxidation has proceeded to a depth of about 400 feet. Above this are carbonate ores of zinc and lead, some oxides of manganese, and limonite; below are the sulphides—pyrite, sphalerite, and galena. The groundwater level is about even with the top of the sulphide zone.

The Lincoln-Lucky mine was developed many years ago, by a tunnel opening on the side of a gulch at the west end of the outcrop of the ore body and continuing along the dip of the formation for over 2,000 feet; or about to the point where the sulphides begin. The recent developments have opened up the ore body to a total distance of 2,750 feet. There are four shafts down to the ore body or below it, the present operating shaft being 550 feet in depth. There is a 450-foot drift and a cross-cut to the vein, where the ore is now being mined.

The present production is 50 tons of crude ore per day. A selective-flotation mill at the mine concentrates the ore 5 to 1. The lead-silver concentrates are shipped to El Paso, Texas, and the zinc concentrates to Amarillo, Texas. The mine is 11 miles from the railroad and the roads are in bad shape during certain seasons of the year.

The future outlook for this property is very favorable for lead and zinc production. There are indications of a lead chimney east of the present workings.

SIERRA COUNTY

Sierra County is on the eastern border of the plateau country. Its west boundary line is the Mimbres Mountains, by which it is separated from Grant County. The general slope is eastward, as far as the Rio Grande. This portion consists of two general types of surface—the mountains and the mesa, or plain, the latter stretching away from the mountains to the valley of the Rio Grande. The Mimbres, or Black, Mountains are a rugged series of elevations running almost due north and south, made up of a core of granitic rock, with extensive flows of rhyolite and andesite making up a large part of the mass. Outcropping sedimentary rocks of Paleozoic age dip steeply away from the uplift and are lost from sight underneath the gravel-covered plain that borders the east side of the mountains.

The mesa portion is covered with loose or consolidated debris washed down from the mountains, called the Palomas gravel; the coarser material is deposited nearest the foot of the mountains and the deposits growing successively finer toward the river. Doubtless, a portion of the most remote of these deposits was laid down in a shallow lake, which at one time covered the lower areas now traversed by the Rio Grande.

Deep drainage courses stretch parallel eastward from the mountain divide, each major valley holding its way regardless of the other, and with few tributaries, carrying its flood-waters directly to the river. These valleys are dry most of the time except in those sections of their lengths that are across solid rock, as at the source. Such valleys, or arroyos, are Cuchillo Creek, Palomas Creek, and Arroyo Seco. Some of the larger of these arroyos carry water near or at the surface through most of their length throughout the year.

Just to the east of the Rio Grande rise the Sierra de los Caballos (Sierra Caballo) and the Fra Cristobal Range. These are typical block-fault mountains, dipping eastward with a steep escarpment to the west. They are uplifts of Paleozoic sediments, underneath which a granite core is here and there exposed. The eastward-dipping structures of these ranges are buried beneath the desert fill of the Jornado del Muerto, in the eastern part of the county.

The Rio Grande has cut a valley to the depth of 300 or 400 feet into the alluvial material of these plains, or through buried ridges of rock lying across its course. Spreading flows of basalt have in some places dammed the course of the river temporarily, until erosion has opened up a narrow gorge through the rock.

APACHE DISTRICT

The Apache district lies along the eastern slope of the Black Range, in the northern part of Sierra County, extending about 15 miles north and south. It joins the Black Range district on the south and is practically continuous with that district. The principal mineralized portion of the district is in the vicinity of Chloride Creek. Ore deposits also occur in the Cuchillo Mountains, which parallel the main ridge on its eastern slope. Chloride and Fairview are the principal centers of population, the remnants of formerly active mining camps. The district was opened up in 1880.

GEOLOGY

The Black Range here constitutes the Continental Divide and also provides a highly mineralized area for exploitation. These mountains are largely made up of successive deposits of extrusive rocks, consisting of flows and breccias of andesite, for the most part, which are covered in many places by rhyolite and rhyolite tuffs and breccias. The underlying andesites have been much altered, or propylitized, by hot solutions, into a greenish-yellow rock; this rock is more open in structure and less firmly consolidated than the original rock. These extrusive rocks extend to the vicinity of Chloride, near the east border of the mountains. Half a mile west of Chloride, on Chloride Creek, they may be seen overlying upturned strata of red beds.

Lying parallel to the main mountain range and a few miles east of Fairview are the Cuchillo Mountains. These are essentially the result of faulting in sedimentary rocks, the upturned portion dipping eastward. Magdalena limestone and overlying red sandstone of the Manzano formation constitute the main rocks of the uplift.

ORE DEPOSITS

The ores of the main range occur as veins in andesite, for the most part. The deposits of the Cuchillo Mountains are associated with sedimentary rocks. The ores of the Black Range and Apache districts in general form two belts extending parallel with the mountains—the belt to the east including the principal gold-bearing veins, and the one to the west carrying mainly copper and silver. The silver-copper belt lies toward the crest of the range; it includes the Silver Monument mine. The gold-bearing belt follows generally the line of contact between the extrusives and the limestones. Phillipsburg and Chloride indicate the general position of this belt.

SILVER MONUMENT MINE

The most active operations at the time of visit were at the Silver Monument mine. This old mine, also called the Virginia Belle, is at the head of Chloride Creek, 9 miles west of Chloride and about 60 miles from Engle, on the Santa Fe railroad. This property is owned by W. C. Mitchell and is being operated by the Betty Compton Mining Company.

The ore body occurs along a fault zone in andesite. The direction of the vein is northeast to southwest and the dip is 75 degrees NW. The ore body varies in width from 1 inch to 7 feet, occurring in pockets or lenses, which are connected by thin phases bearing no ore. The ore of the enriched zone is mainly bornite, carrying some silver and gold. The average shovel value is said to be $51.10 per ton. The ore indeed looks very rich. The bottom of the enriched zone is about on the level of the main tunnel, or 800 feet from the surface, or top of the mountain. Below this the ore is mainly chalcopyrite.

DEVELOPMENT

Over 8,000 feet of development work has been done. A tunnel 1,850 feet long runs about south into the mountain, on the south side of the canyon. At about 1,500 feet from the portal this tunnel cuts the vein of ore, which runs at an angle of about 40 degrees with the tunnel. The ore is concentrated at the mine by a 50-ton flotation mill.

This mine has produced $680,000 in all; one ore shoot 40 feet high, 100 feet long, and 6 to 8 feet wide is said to have yielded $90,000.

In June, 1926, the mine was changing owners. At that time there were 600 tons of ore ready for milling and 1,000 tons in sight in one stope. The outlook for a large production from this mine seems favorable.

UNITED STATES TREASURY MINE

The United States Treasury mine is located across the mountain south of Chloride Creek and about 10 miles east of the Silver Monument; it is also 3 miles southwest of Chloride. This mine is sometimes known as the Great Southwest. The company operating built a cyanide mill several years ago, but owing to faulty principles of construction the mill did not operate in a practical manner, resulting in the bankruptcy of the company and the closing down of the mine. The last work in the mine was in 1907. The property is now under litigation and will not be opened up immediately. Ray Grayson, of the Betty Compton Mining Company, is manager. It is expected that the mill will be reconstructed, fitted with up-to-date equipment, and put upon a paying basis. There are two patented and two unpatented claims in the property. The ore is low-grade, carrying gold and silver values. The vein is from 9 to 40 feet wide, running N. 70° W. and dipping about 75° SW. The principal gangue is white quartz. The wall rock is a grayish-yellow propylitized andesite. Half a mile farther east the vein enters overlying limestones of Pennsylvanian age. In the limestone the vein is said to carry chiefly lead, in a gangue of quartz, barite, and calcite.

The ore averages $7.50 per ton, and 40,000 tons of ore are said to be blocked out. The future outlook is good.

BALD EAGLE MINE

The Bald Eagle property consists of six groups of claims 6 miles southwest of Chloride. James brothers and Dines are the owners.

The ore occurs in andesite in a vein 2 to 6 feet wide. The ore is galena, 10 to 70 per cent, and chloro-bromide of silver, which assays from 50 to 500 ounces of silver, 0.5 to 2.5 ounces of gold, and 2 to 4½ per cent of lead. The shipment values are 2.9 ounces in silver, 0.003 ounce in gold, and 38.2 per cent in lead.

There is a shaft 80 feet deep, with a total of about 360 feet of development work. The distance from the railroad is 50 miles, and the ore is shipped to the El Paso smelter. The property is said to have the "earmarks of permanency."

DICTATOR MINE

The Dictator mine is located in the Cuchillo Mountains, in the eastern part of the district. This property, owned by F. H. Winston, of Fairview, N. Mex., is under lease by Messrs. McKinney and Parker.

The country rock is Carboniferous limestone, as the hanging wall, and monzonite, as the foot wall. The ore body is at the contact, and is 2 to 10 feet wide. The ores are carbonates and sulphides, containing zinc, copper, lead and silver. The shipment values are, in lead, 50 per cent; in zinc, 50 per cent.

There is 100 feet of tunnel, shafts, and cross-cuts. The mill produces 2 tons of concentrates per day. This property is 50 miles from the railroad, and the concentrates are shipped to the El Paso smelter.

FAIRVIEW

Fairview has few actively producing mines. There are several prospects in the vicinity, where some development work is being done. On Rafferty Creek, 15 miles from Fairview, gold, silver, and copper are said to occur; and on Bear Creek, 15 miles above Fairview, are iron, silver, and lead. C. H. Laidlow is developing a prospect 5 miles east of Fairview.

BLACK RANGE DISTRICT

The Black Range district occupies the northwestern corner of the county to the east of the Black Range of mountains. The district extends a short distance into Socorro County. The general structure and the mode of mineralization are like those represented in the Apache district. Phillipsburg and Grafton were the chief mining centers years ago. The district has never been important as a producer.

KINGSTON DISTRICT

Kingston is 9 miles west of Hillsboro and near the head of Percha Creek. It is 26 miles from Lake Valley, the nearest railroad station. Silver was discovered in the district in 1880. Kingston district at one time had a population of 2,000, but now there are scarcely 100 persons living in the district. Kingston itself has a population of less than a score, and its uninhabited condition contrasts strangely with the elaborate two-story stone buildings which accommodated its former active citizenry. The financial crisis of 1893 contributed to its decadence.

The general structure of the Black Range in this district is a core of granite and schists, with sedimentary beds dipping away on both sides. Faulting has displaced the beds in several places, and flows of andesite and rhyolite, with tuffs and breccias, cover much of the surface. To the west of the town of Kingston a dike of monzonite porphyry about 400 feet thick cuts the limestones, and it is along the contact that most of the mineralization has occurred. According to C. H. Gordon,[26] the sedimentary formations comprise practically a continuous series of Paleozoic deposits.

The ores occur principally along the contact of the dike with the limestone, on the west side of the dike. They appear as pockets and pipes in the limestone just below a black shale—Percha shale. The ores consist principally of silver, in lead and copper sulphides. Some gold also is carried. Zinc and lead occur in the higher part of the range, in limestone.

EMPIRE ZINC COMPANY MINES

The Empire Zinc Company has large holdings and has leased several of its claims to the Black Range Development Company. This company is taking quite a tonnage from the Matchless, the Iron King, and the Climax mines, about 1 mile from Kingston. The ore is said to be high in lead and zinc, with a good deal of copper. Operations have just begun and shipment is expected to follow as soon as the road to the mines is completed. A small force of men is at work.

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[26] Gordon, C. H., Prof. Paper 68, p. 224, 1910.

OTHER PROPERTIES

The Percha Mining Company has been working the Forest King mine, located on South Percha Creek, 5 miles southwest of Kingston. They have opened up a large body of lead and zinc ore, with some high-grade silver. The ore carries considerable copper. The prospect is closed down temporarily.

A. M. Keith, in 1926, was trying to develop the Comstock, the Black Colt, and the Lady Franklin mines. He has found a new strike of ore on the Black Colt, yielding $500 to $700 per ton in silver, according to reports.

The O. K. mine, half a mile east of Kingston, was being developed by Ellsworth Bloodgood.

The Gray Eagle mine, 4 miles south of Kingston, has a large body of lead and zinc, carrying silver and gold. This mine is owned by a New York company. Some ore has been shipped and development is going on.

The Virginian mine, owned by John H. Moffitt, is on a fissure vein. It is located about 1 mile north of Kingston. This property is being developed and a 50-ton flotation mill is to be installed.

It thus appears that, although no production is coming from this district, the general interest in mining here is increasing, and some development work is going on. Kingston is said to have produced the largest amount of silver ore of any camp in New Mexico. One ore shoot, or "slip," produced $1,000,000. Jones[27] estimates the production, up to January 1, 1904, as $6,250,000.

SHALE AND PUMICITE

Two miles below Kingston, on Percha Creek, is an exposure of Percha shale 400 feet thick. This shale is black and very fissile. It doubtless would be suitable as a brick or cement material.

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[27] Jones, F. A., op. cit., p. 98.

Still farther down the Percha Canyon—5 miles from Kingston—is a deposit of pumicite, or volcanic dust. The deposit is about 15 feet thick and it occurs on both sides of the canyon. While considerably mixed with sand and coarse volcanic debris, it is possible that large bodies of the material might be found in the deposit.

CARPENTER AND HERMOSA DISTRICTS

The Carpenter district is on the west slope of the range, about 6 miles southwest of Kingston. It was not visited by the writer. The principal ores are lead and zinc. The district is too inaccessible for profitable development and has remained unexploited for 40 years.

Hermosa district has produced about $1,250,000, but there is no production at present. The camp is on Palomas Creek, about 15 miles south of Chloride and 35 miles from Engle. There are two centers of mineralization. The ore at Palomas camp—about 1 mile below Hermosa—occurs in pockets and pipes in limestone and underlying a bed of shale. The shale is not fractured, but the limestone is traversed by many faults and joints; and it is along these fractures—especially at their intersections—that the ores occur. These rocks are of Pennsylvanian age.

HILLSBORO (LAS ANIMAS) DISTRICT

Hillsboro is located 18 miles west of the Rio Grande and 17 miles from Lake Valley. The district includes an area about 8 miles square which is crossed near the south end by the Percha Creek. Gold was discovered in the district in 1877. The total production up to January 1, 1904, is placed at $6,750,000,[28] principally in gold. Since that time several mines are being reopened and important developments are being made in placer mining.

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[28] Jones, F. A., op. cit., p. 83.

GEOLOGY

The approach to Hillsboro from the east is over a mountain of andesite and limestone. The town is situated on a gravel deposit, called the Palomas gravel, which extends outward from the base of the mountains, forming a broad, flat apron along their eastern front. Percha Creek flows through the town. About a mile east of Hillsboro there is an uplifted block of Mimbres Limestone, against which the gravel deposits abut. The amount of vertical displacement along this fault is thought to be as much as 2,000 feet, although the exposed section is less than that. Percha Creek has cut its way across this uplift in a narrow gorge.

Just to the north of the town is a lava-topped mesa, half a mile or so wide. This lava-flow is on top of Palomas gravel, and has protected that deposit from erosion, on that account. Two miles or more to the northeast of Hillsboro occur extensive flows of andesite (or latite), forming a group of mountains, extending still farther toward the northeast. These mountains are about 1,000 feet high above the surrounding country. The most prominent of this group is Las Animas Peak.

ORE DEPOSITS

Gordon[29] classifies the ores of this district into three types—(1) those containing lead, iron, and manganese, occurring at the top of the Mimbres limestone; (2) those containing gold, silver, and copper, in single veins or in shear zones in the andesite; and (3) placers.

Ores of the first type occur associated with vanadium minerals along the contact of the Mimbres limestone and the overlying Percha shale, in the vicinity of Percha Creek.

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[29] Gordon, C. H., op. cit., p. 275.

Hillsboro is best known as a gold producer. The placer deposits were supposed to have been exhausted many years ago. The second type of ore deposits occurs on the southern slope of the mountains, about 2 miles northeast of Hillsboro. Shear zones are said to radiate from the region of Las Animas Peak, and there are many of them cutting the andesite. The ores are mainly sulphides of copper carrying gold and silver.

MINES

Some of the most important mines are the Snake and the Opportunity, lying about 2 miles northeast of Hillsboro. These old mines have lately come under new management. Just west of these mines in the Bonanza group, which is now under lease by W. D. Slease and D. B. Whitton, of Hillsboro, N. Mex. Gold occurs as free-milling and also in combination with copper sulphides carrying silver. The general run of the Bonanza mine is $60 to $150 per ton.

The future of these mines, and others in this district, seems hopeful. Many new people are coming in and are taking hold of the problems of development. Properties that have lain dormant for 12 or 15 years are being reopened. At the time of visit over 40 claims were under development.

GOLD DUST DISTRICT

A portion of the old Las Animas district lying 6 miles northeast of Hillsboro, and 27 miles southwest of Hot Springs, is now known as the Gold Dust district. There is a good road from the district to Lake Valley, the nearest railroad station, 27 miles distant. This area embraces several square miles to the east of the andesite hills and Las Animas Peak. The surface slopes gently from these elevations to the broad plain reaching to the Rio Grande valley. This plain consists of gravel and sand, called the Palomas gravel, washed from the hills to the west, which have thus contributed a large part of their original mass.

The district has been developed only within recent years. Apparently, a large body of gold-bearing gravel exists here. The ore is entirely a placer deposit, consisting of black sand and gold dust. From less than an acre of ground, within 5 feet of the surface, George Wells took out $90,000, according to report.

The prospects for future development seem very good. Many mining companies are arranging for operations here. The principal company now operating is the Gold Dust Placer Company, Gold Dust, N. Mex., via Hillsboro. This company is operating a drag-line, which conveys the gravel into a hopper, where it is washed through a 100-foot sluice box, removing about 80 per cent. Water is obtained in ample quantity from wells sunk in the Palomas gravel.

LAKE VALLEY DISTRICT

The Lake Valley district embraces a few square miles in the vicinity of Lake Valley, the terminus of a branch of the Santa Fe railroad connecting with the Silver City branch at Nutt, 12 miles southeast. Silver was discovered here in 1878. A few years later, the Bridal Chamber was discovered, which proved to be one of the richest bodies of silver ore ever found in the world.

Extensive deposits of andesite and rhyolite cover much of the region. Beginning at Lake Valley, and extending northward more or less connectedly to Hillsboro, is an outcrop of Paleozoic sediments, which has been brought up by a fault and has been denuded of any igneous deposits that may once have covered it. The sedimentary beds dip toward the east, their harder layers forming low escarpments, while strike-valleys have developed along the outcropping softer materials.

The ores occur in a blue-gray limestone of Mississippian age. The deposits seem to be replacements in the limestone. Besides the ores there is considerable chert, or jasper, of different colors. The ores and cherts evidently were deposited from hot, ascending solutions. The deposits occur the most abundantly at the crossing of faults. In general they follow the planes of bedding and occur below andesite or shale. The ore bodies are very irregular in shape, forming pockets or pipes in the Lake Valley limestone. The silver occurs as cerargyrite and in galena. In addition to the silver ores there is considerable iron and manganese[30]; galena and vanadinite are found in small amounts.

The total production of the district is estimated at 15,000,000 to 17,000,000 ounces of silver. Little has been produced since 1893. Some production has been made during the year of 1926; the first half of the year 15,000 tons of ore from the old dumps yielded 4 to 8 ounces of silver to the ton. Manganese is not produced any more; it has a high percentage of silica. During the last 10 years about 40,000 tons of ore have been shipped, yielding under 20 ounces of silver per ton.

TIERRA BLANCA DISTRICT

The Tierra Blanca district is about 15 miles northwest of Lake Valley and 6 or 7 miles southwest of Kingston. The structural conditions are similar to those at Kingston.

The ores are silver chloride and free gold; no lead is found. The district is said to have produced 100,000 tons of ore containing 7 or 8 ounces of silver per ton, and some gold. At present, mainly assessment work is being done.

One of the most likely deposits in this district is the Casey property. Several years ago about 30 tons of ore were packed out, netting $50 per ton. A. L. Owen, of Deming, has interests at the Casey mine; he also owns the Royal

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[30] Wells, E. H., op. cit., pp. 58-61.

John, on the west side of the range. The Royal John is said to be very extensive and very rich in copper, lead, and zinc. Negotiations were under way in 1926 for the installation of a flotation plant. This deposit can be reached from Hot Springs or from Mimbres.

PITTSBURG DISTRICT

The Pittsburg district is east of the Rio Grande and west of the Sierra Caballo. The importance of the district in the past lay in the production of placer gold. The discovery of gold is said to have been about 1901. The principal area of production was along Trujillo Gulch. Of a total production of 3,427 ounces of placer gold in Sierra County in 1904-1905, the greater part came from the Pittsburg camp. Since that time little has been produced.

The district is at present important as a coming fluorspar and lead producer. About 10,000 acres are said to have showings of fluorspar, with some lead and manganese. The New Mexico Fluorspar Corporation owns extensive properties near Derry. All their holdings, of 22 claims, show a high grade of fluorspar. This property is under lease by Francis C. Merrill, of Las Cruces, N. Mex., who is putting in a 300-ton mill for concentrating the ore. These deposits are about 22 miles from the railroad, at Hatch, whence the product will be shipped to eastern markets.

The deposit in the Lyda K., Nos. 1 and 2, occurs as a fissure vein 4½ feet wide, with an outcrop of 2,000 feet. At present there is one 76-foot shaft and one 40-foot tunnel, with numerous open cuts.

RIO GRANDE MINE

The Rio Grande mine is located on the east side of the Sierra Caballo, 23 miles from the railroad. The owner is P. Langdell, Arrey, N. Mex. Deposits of lead and fluorspar in considerable amounts occur, in fissure veins in granite and limestone. Some development work has been done, but there is no active mining at present, as the distance from the railroad is too great. It is believed, however, that in time the bodies of ore now in sight will warrant development.

WHITE STAR, OAKLAND, AND UNIVERSAL MINES

The White Star Nos. 1 and 2, the Oakland Nos. 1 and 2, and the Universal are a group of claims owned by the Fluorspar Mines of America, Inc., C. B. Hanson, Hillsboro, N. Mex., manager. These claims are located on the west slope of the Sierra Caballo, 4 miles southeast of Hot Springs.

The deposit consists mainly of fluorspar, in a gangue of silica and calcite. A small amount of galena accompanies the deposit. The ore occurs in fissure veins 10 to 15 feet wide.

The claims have not yet been brought into production. The deposits are 26 miles from the railroad, and the condition of the country roads is such as to prevent hauling by truck to the station.

CABALLOS DISTRICT

The boundaries of the Caballos district seem to be not very sharply defined from the Pittsburg district; but the Caballos district includes particularly the north end of the Sierra Caballo. These mountains are uplifted along a north and south fault, with a steep escarpment on the west and eastward-dipping sediments on the east. An outcrop of granite occurs at the base on the west side of the range. The mountains are cut by several east and west faults, some of which are ore-bearing.

Lead and copper deposits occur in the district, and some development work has been done. The principal mineral deposit now being developed is fluorspar.

Paul Larsh is opening up a fluorspar property 12 miles southwest of Cutter, on the east side of the Sierra Caballo.

It is possible that some of the old workings in the district may be made to produce both fluorspar and lead.

Several manganese deposits occurring in Sierra County are described by Wells.[31]

SOCORRO COUNTY

Socorro County, like Sierra, lies toward the eastern border of the plateau region. Its western portion is included in the plateau country, while its eastern limits extend well to the plains area. West of the Rio Grande the surface is largely mountainous, but with many broad intervals of level or rolling prairie. The principal mountain groups are the San Mateo, in the southwest; the Magdalena-Socorro, in the central part; and the Datil, in the northwest. Ladrone Peak is a conspicuous landmark in the northern part. These mountains consist largely of rhyolitic and andesitic flows and breccia, of Tertiary age.

The drainage is mainly toward the Rio Grande, but there are no permanent streams. The San Augustin Plains are an extensive structural basin, grass-covered, stretching southwestward from the western part of Socorro County a distance of 60 miles, with an average width of 15 miles; mountains rise on all sides. East of the mountainous district is a belt of gently-sloping mesa 6 to 10 miles wide, reaching to the Rio Grande. This is trenched with numerous arroyos, which carry the floods of mountain storms.

The portion of the county to the east of the Rio Grande consists mainly of barren or sparsely-grassed plains, which are broken, near the east border of the county, by the Oscura Mountains and the northward extension of the San Andres Range. Chupadera Mesa is a broad, somewhat isolated structural uplift, consisting of Carboniferous sediments, occupying the eastern portion of Socorro County and extending into Torrance County.

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[31] Wells, E. H., op. cit., pp. 58-68.

The slight rainfall of the area east of the Rio Grande scarcely reaches the river by surface drainage, and watercourses here are noticeably absent. Jornado del Muerto (journey of death) is a waterless, barren plain reaching westward from the San Andres Mountains nearly to the Rio Grande and extending from Dona Ana County northward nearly 100 miles.

Southeast of San Marcial is an extensive area of basalt, which forms a conspicuous escarpment just east of the Rio Grande in that vicinity.

SOCORRO PEAK DISTRICT

The region of Socorro Peak was once considered a mining district. Socorro Peak district was prospected as early as 1867, and it is said that there were evidences of still earlier mining on Socorro Peak. According to Jones[32] the district produced $760,000, mainly in silver; but there is no longer any production.

SILVER MOUNTAIN DISTRICT

The Silver Mountain (Water Canyon) district lies on the east side of the Magdalena Mountains. It is an extension of the Magdalena district southward and has similar geologic conditions. Prospecting began here in 1868.[33] Since that time, mining has been conducted in a desultory manner, with no appreciable results, although considerable capital has been sunk in various attempts at development. The southern, or upper, part of the district holds values principally in gold and silver; the lower part has copper and some lead.

At the present time a good deal of development work is going on. The ore is usually of good grade, running from

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[32] Jones, F. A., op. cit., p. 111.

[33] Jones, F. A., op. cit., p. 126.

$25 to $150 per ton. During 1926 several carloads of such ore were shipped, according to Nathan Hale, of Water Canyon, N. Mex.

MAGDALENA DISTRICT

The Magdalena district includes the northern part of the Magdalena Range. It has within its limits the towns of Magdalena and Kelly. Magdalena is the terminus of the branch line of the Santa Fe railroad running west from Socorro, a distance of 26 miles. It is situated in a narrow plain, which widens out to the east and the west. The mining camp of Kelly is about 3 miles southeast of Magdalena and 1,000 feet higher, on the lower part of the mountain slope. The Magdalena Mountains extend southward from here a distance of about 25 miles. The highest point in the range is 10,800 feet. These mountains are separated from the Rio Grande on the east by a lower range, including Socorro Peak, while across a broad plain southwest rise the San Mateo Mountains.

GEOLOGY

The general structural features of the district in the vicinity of Kelly are a series of much-faulted and westward-dipping Carboniferous sediments resting upon a pre-Cambrian complex of schists and granites. The basal sedimentary rocks consist of limestones about 125 feet thick—the Kelly limestone. A prominent member of this series is a fine-grained gray limestone called the Silver Pipe. It is supposed that the Kelly limestone is of Mississippian age.

Above the Kelly limestone occurs some 1,000 feet of the Magdalena group, consisting of conglomerates, shales, and limestones. All these sediments have a dip of 30° to 60° W.

The principal igneous rocks affecting mining operations are dikes of "greenstone," or diabase, which cut the sedimentary beds in numerous places.

ORE DEPOSITS

The principal ore deposits of this district are lead and zinc, occurring mainly as sulphides, the carbonates having been largely worked out. The ore occurs as a replacement in limestone. In general, the Kelly limestone is the ore-bearing member, and the main body of ore is found just under the Silver Pipe limestone. The sulphides are believed to be the result of upward-moving hot solutions, while the carbonates were deposited from downward-moving cold solutions.

The time of the deposition is placed by Gordon[34] in the Tertiary period, following the intrusion of certain bodies of granite porphyry which bound the area on the west, but before the formation of the greenstone dikes.

WALDO MINE

The principal operations in the district in 1926 were at the Waldo mine—formerly called the Kelly mine. This mine was being worked in combination with the old Graphic mine, by the Ozark Smelting and Mining Company. Ore was discovered in this district by J. S. Hitchinson, in 1886. The first claim staked out was the Juanita, and the second was the Graphic. Soon after the discovery the mines were producing. Lead ore was smelted in an adobe furnace and the bullion was hauled to Kansas City, Mo., by ox teams. The first ores to be mined were, naturally, the carbonates. The mines were worked more or less intermittently for many years. Considerable work under lessees, without care for the future, has hindered the proper development of the mines. Long periods of inactivity resulted in cave-ins and lost stopes. At the present time the Waldo is the only mine in the district that is not under lease, and work here is being carried on systematically and with regard for the future. The ores occur mostly in the Kelly limestone, which overlies the pre-Cambrian schist. At the north end of the deposits the ores are found in contact with monzonite; on the west side, in contact with granite porphyry. The ore bodies are irregular in shape, and vary much in size. The beds are frequently faulted. In some cases the ore bodies seem to have been formed before the faulting; in other cases the ores themselves have evidently been deposited along fissures and faulting dikes. Dikes of diabase also cut the ore bodies, and some faulting has occurred since the main deposition of ore after the intrusion of the dikes. The sulphide ores occur mainly beneath low arches of impervious rocks, thus indicating their deposition by hot upward-moving solutions.

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[34] Gordon, C. H., op. cit., p. 255.

The ores now being mined are mostly zinc sulphides. Formerly, in the upper zone, the oxidized ores of zinc, lead, and copper were mined.

In the Waldo and old Graphic mines there are approximately 40 miles of workings. The ores are concentrated at the mine, by flotation, about 3 to 1. The present production is 150 tons per day.

The future of the district will depend much on the results of the Waldo deep workings. It is thought that good deposits of ore will be opened up where the Kelly limestone is in contact with the granite porphyry on the west. Should this test fail, further attempts to exploit deep deposits would be delayed.

ROSEDALE DISTRICT

The old mining camp of Rosedale is located about 25 miles south of Magdalena, on the east slope of the San Mateo Mountains. Mr. J. H. Robb was the sole survivor of this camp when it was visited by the writer. He still has faith that operations will be resumed there some day. The mines were worked for 15 years and have been abandoned for about that long. The ruins of an old stamp mill, and caved-in workings, mark the site of active operations of years ago.

Rosedale is situated at an elevation of 7,000 feet, about 2 miles up the Canyon from the general edge of an open plain stretching to the Rio Grande valley. It is naturally well located as a summer resort, except for the absence of water, which has to be brought from the lower end of the canyon, 2 miles away.

The prevailing rock of the San Mateo Mountains is rhyolite. At the base of the mountains and out upon the sloping mesa, deposits of rhyolitic breccia are common.

The ore is mainly free-milling. The ore body is a quartz vein about 4 feet wide traversing the rhyolite northwest to southeast. The average assay value of the ore is said to be about $10 per ton.

The mine still holds possibilities, but it could not be opened short of a cost of $12,000. Water used to be brought to the camp by a pipe line several miles long, but that has failed to function for many years.

JONES DISTRICT

The Jones district is located toward the north end of the Sierra Oscura range. The district was named in honor of Fayette A. Jones, who, in 1902, made an examination of the iron deposits in that vicinity.

The principal mineral deposit is a body of iron ore, which occurs on the eastern slope of the Sierra Oscura, at an elevation of 6,700 feet. The deposit is about 35 miles east of Carthage and 20 miles west of Coyote station, on the Southern Pacific railroad.

The deposit has been prospected for a distance of nearly 10 miles, and in some places considerable development work has been done. The camp is now abandoned. There is exposed on the surface and developed along the outcrop approximately 250,000 tons of ore. No ore has ever been shipped, because of lack of transportation.

The ore occurs along the contact of Carboniferous limestone with a monzonite dike, for a distance of 10 miles, nearly due east and west—transverse to the direction of the mountain range. The monzonite is exposed as a ridge and the ore is associated with gypsum beds. The deposit is supposed to be the result of contact metamorphism.

SALINAS PEAK DISTRICT

The Salinas Peak district is toward the north end of the San Andres Mountains, in the southeastern part of the county. The San Andres Mountains are reported to be very highly mineralized. These mountains consist of a fault-block tilted toward the west. An escarpment similar to the west front of the Sandias faces the east here. Between the San Andres, on the west, and the White and the Sacramento mountains, on the east there is a sunken block or "graben," which went down as the mountains on each side were upraised. The San Andres Mountains, for much of their extent, are quite remote from the railroad and difficult of access.

According to Frank Skidmore, of Tularosa, N. Mex., these mountains contain appreciable amounts of the following minerals or ores: Lead, zinc, cadmium, tungsten, molybdenum, bismuth, talc, kaolinite, and fluorspar. J. D. Gwin, of Tularosa, has been doing some prospect work on the north side of Salinas Peak, 40 miles northwest of Tularosa. At this place is an old lead camp, which was worked 22 years ago. The lead ore is said to average 58 per cent metallic lead, with some zinc. This property is near the old Davenport property. The ore body is in limestone, but it is very siliceous. Molybdenite and bismuth occur near. These prospects are about 25 miles from Lava station, on the Santa Fe railroad, which is the nearest shipping point.

NON-METALLIC DEPOSITS

Materials of economic importance occur, other than the metallic ores. Deposits of this nature that may be mentioned are volcanic dust and volcanic glass. About 3 miles northeast of San Antonio there is a bed of volcanic dust, or pumicite, located in the edge of the mesa overlooking the valley of the Rio Grande to the west. The deposit extends along the escarpment for a distance of a mile or so, varying in thickness from 7 to 12 feet. The quality of the pumicite varies considerably, there being interlayered beds of sand or other impurities, which may be sufficient to render the deposit useless for the purposes to which pure pumicite is generally put. The source of the deposit was probably in the active volcanoes that at one time existed in the region of the Socorro Mountains. Similar deposits are likely to be found within this radius.

Section of pumicite deposit near San Antonio, N. Mex.

	Ft.	in.
Gravel and sand	0-10	0
Pumicite, with fragments of pumice stone somewhat cemented by caliche	1-7	0
Pumicite, massive	3-3	6
Pumicite, pure, white		1-4
Clay		3
Sand, very fine	1	0

Volcanic glass, or obsidian, occurs in certain places in the county. While none of these were seen by the writer, he was shown several pieces of this material by W. J. Joyce, cashier of the First National Bank, of San Marcial, N. Mex. These samples were of a dark red color, somewhat translucent. The location of the deposit is in the southern end of the Magdalena Mountains. Another locality is in the San Mateo Mountains, west of San Marcial.

Several deposits of manganese in Socorro County have been described by Wells.[35]

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[35] Wells, E. H., op. cit., pp. 67-81.

TAOS COUNTY

The western half of Taos County is covered with basaltic lava, which is sparsely covered with soil and gravel. This flow of lava is trenched for many miles by the Rio Grande and its tributaries, exposing underlying sedimentary rocks 1,000 feet below the top of the lava. The lava itself comprises only about 200 feet of the total exposure; the material underneath is largely of unconsolidated sandy material.

The east side of the county is occupied by the Taos and the Mora ranges, which are a part of the Sangre de Cristo Range. These ranges rise to an elevation of over 12,000 feet, while Taos Peak reaches 13,145 feet. The Sangre de Cristo Range forms the east boundary of Taos County and continues southwestward past Santa Fe. From Elizabethtown south the main range consists of uplifted Carboniferous strata, while farther north the pre-Cambrian granites and schists prevail. Near the Colorado line the sedimentary series are steeply uplifted against the eastern foot of the range.

The Rio Grande traverses the county from north to south and is the principal drainage course of the county. Tributary drainage is well established on the east side of the Rio Grande, but on the west the wide plateau of basalt has few water-courses.

RIO HONDO DISTRICT

The Rio Hondo district lies along the Rio Hondo, on the west slope of the Taos Mountains, at an elevation of about 8,000 feet.

Placer gold was discovered on Arroyo Hondo by the Spaniards, in 1826. According to Jones[36] the ore lies at the contact of a porphyry dike with schist. The principal mine of the district was at Twining, called the Fraser mine. Considerable development was made at this mine, and a concentrating mill and smelter were erected. The plant was not successful, owing to the low grade of the ore and the high cost of operating. The principal ore was chalcopyrite and bornite.

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[36] Jones, F. A., op. cit., p. 157.

Recently, placer gold has been developed on the Arroyo Hondo by A. J. Torres and George F. Cooke, of Taos, N. Mex. According to Mr. Torres, an area of 3 square miles is gold-bearing. The average yield of gold per cubic yard is said to be 50 cents; and in places as high as $50 per cubic yard was assayed. The location seems to have possibilities of commercial development. Some lead ore also is reported from this district.

The district is about 35 miles from the railroad.

RED RIVER DISTRICT

The Red River district is in the eastern part of the county, about 20 miles south of the Colorado line. The Red River flows through the district, westward. The main mining camp was at Red River, which is today a partly deserted village picturesquely situated toward the upper part of Red River valley, at an elevation of 9,000 feet. Prospecting for gold is said to have begun in this district in 1869. The district has not produced very much gold.

GEOLOGY

The core of pre-Cambrian schists and granites, of the range, is here somewhat overlain and obscured by later intrusions and extrusions. There seem to be two kinds of these later formations—one, the older of the two types, being an intrusion of monzonite porphyry, or granodiorite; the other type consisting of flows of andesite and rhyolite.

ORE DEPOSITS

The principal metal produced in this district has been gold; but some silver, copper, and lead accompany the main ore in some places. The common mode of occurrence of ores is in veins in the monzonite porphyry. These veins also frequently cut the rhyolite and the andesite. The veins are usually narrow, and often brecciated, with an abundance of quartz filling the spaces between the fragments of the wall rock or replacing the walls and the included fragments. Pyrite is the most abundant metallic mineral, and galena and sphalerite occur in small amounts in certain places. Molybdenite sometimes occurs, as a thin coating on fragments where fracture has taken place. There is little depth to the oxidized zone, as the steepness of topography and the large amount of rainfall tend to keep the surface free from accumulated debris. The total production for the district was not large. More than a dozen mines were developed to some extent, but at the present time there is no production of gold. Prospecting is being done in a desultory sort of way by a few people of the village of Red River.

CABRESTO AREA

Canyon Cabresto joins Red River at Questa. The area is designated as the Cabresto section of the Red River district. About 2 miles above the junction of these canyons, on the north side of Cabresto Canyon, is located the Weary Willie group of claims, owned by Edward Carpentier, of Red River, N. Mex.

ORE DEPOSITS

The ore occurs in a brecciated zone between quartzite and porphyry; the hanging wall is quartzite and the foot wall porphyry. Large, angular fragments of the quartzite are imbedded in the ore body. In size, the ore body varies from a few inches to 6 feet in thickness.

The principal ores are lead and zinc—8 per cent lead and 10 per cent zinc. The zinc ores are about equally divided between the carbonate and the sulphide.

DEVELOPMENT

Active work is going on at this place. There are four tunnels, with about 650 feet of work, altogether. About 200 tons of ore are on the dump and possibly 700 tons in sight. It is the intention of the operator to follow under the ore body, with upraisings every 50 feet, and cutting through the vein. This property is 30 miles from the railroad and is somewhat handicapped by poor roads.

OTHER DEPOSITS

Very large graphite deposits are reported, between Cabresto and Sunshine Valley. Some iron ore also is said to occur there.

MOLYBDENUM MINE

The most active scene of present mining operations in this district is the mine and mill of the Molybdenum Corporation of America, located on the Red River 7 miles east of Questa. The mine was first opened in 1917. The present company began operations in October, 1923. At the time of visit there was about 18,000 feet of development, and the work was progressing at the rate of 600 to 700 feet per month.

ORE DEPOSITS

The country rocks are diorite, granodiorite, and quartz porphyry. The ore occurs in veins in the granodiorite, especially where vertical and horizontal fissures intersect. The veins run, for the most part, north 65 degrees east. The ore body is very erratic—now opening out in wide masses, now pinching out to a mere sheet of ore. The mineralized area extends over several miles, east and west, but is much narrower north and south.

The molybdenite occurs as a coating, or a rather thin deposit, on the walls of veins and in narrow seams throughout the granodiorite. The average grade of the ore is 6.5 per cent molybdenum sulphide.

CONCENTRATION

The mill is located about 1 mile from the mine, near the road along Red River. The capacity is 24 tons per day; and the concentration is by flotation, in the ratio of 12 or 15 to 1. The concentrates are reduced at Washington, Pa. The annual production is 600,000 pounds of molybdenum sulphide, molybdenite.

OTHER MOLYBDENUM PROSPECTS

The Hercules Molybdenum Corporation mine is located near the mine just described. Farther down the canyon of Red River, 3 miles east of Questa, is the property of the Mammoth Molybdenum Corporation, while 3 miles southeast of Questa is the Fibbs-Nogle prospect. None of these properties has been developed to a state of production.

FUTURE OUTLOOK

The mine of the Molybdenum Corporation of America is 30 miles from a railroad. Distances for hauling, such as this, and poor condition of roads are some of the handicaps to the development of all these mines. Yet it is perhaps possible that, with energy, purpose, skill, and capital, other ore deposits in the district could be brought to commercial production. In the opinion of some of those who are most acquainted with the situation, the condition of the district is, "hopeless unless new blood, intelligence, and financial strength be brought here. The district is ill, being filled with precipitates, small-stock schemers and parasites, who have nothing to show. The worthwhile showings are patented, and the owners are looking for unreasonable prices." It is believed, however, in contrast to the above conditions, that there are strong showings of copper, which cover a large area. These could be taken up, being still open for location. The patented claims are mainly gold, but it is the opinion of Mr. Carpentier that the main development of the Red River district will be in copper.

OTHER DISTRICTS

Several other mining districts have been developed to some extent—such as the Anchor, about 8 miles northeast of Red River; the La Belle, just over the divide from the Anchor, and 12 miles north of Elizabethtown; the Glenwoody, on the Rio Grande a few miles above Rinconda village; and the Copper Hill (or Picuris), about 12 miles east of Embudo station. None of these districts ever produced very largely and all are now inactive. In the Copper Hill district the pre-Cambrian metamorphic rocks prevail, and these are traversed by quartz veins carrying small values of copper, silver, and gold. The schists contain a variety of minerals such as tourmaline, garnet, corundum, andalusite, and staurolite.

MICA

Mica claims of the Western Mica Company, of Denver, Colorado, are being developed by Messrs. Davis and Thurber, of Ojo Caliente, N. Mex. These claims are located about on the line between Taos and Rio Arriba counties, 1½ miles northwest of Ojo Caliente.

This property is producing 100 to 125 tons of mica per month. It is believed that the production can be doubled. The mining at present is by open cut. Later a tunnel will be driven, with raises.

The future outlook of this mine seems good. The claims are within 2 miles of a branch of the Denver and Rio Grande railroad, from Stong to La Madera. The district has been put in an unfavorable light by former operators who failed to make deliveries according to agreement.

LEPIDOLITE

For several years a body of lepidolite has been worked, in the Copper Hill district, though no mining was done in 1926. This mine is located 12 miles east of Embudo and is operated by the Mineral Mining and Milling Corporation, of 50 Murray St., New York.

The region is underlain by pre-Cambrian schists and intrusives. The ore occurs in a pegmatite dike, which cuts the schists or follows the plane of schistosity. The outcrop runs nearly due east and west, for a distance of nearly a mile. The presence of the dike is indicated by ledges of white quartz, which accompany the minerals of the ore body and which have resisted erosion more than the rest. The dike varies in width from a few feet to several rods. The dip is steeply to the south, mainly along the dip of schistosity of the enclosing rocks. Large crystals of spodumene strike through the ore body; feldspar and a blue fluorite also are accessory minerals. The grade of the ore is very high.

Mining began here in 1919. Up to 1923 there had been some shipment of ore to New York. The development of the ore body was then going on, but there was some doubt as to the extent of the deposit.

The company has established a mill at Embudo, where the ore is ground and prepared for shipment directly to buyers. About 2,500 tons is the production per annum, which is distributed to glass works from coast to coast.

TABLE OF FORMATIONS COMMON IN NEW MEXICO

(Compiled from U. S. G. S. data)

- Quaternary.
- Tertiary.
  - Pliocene-Miocene.
    - Santa Fe formation (Ogalalla).
  - Eocene.
    - Wasatch.
    - Puerco (Raton).
- Cretaceous (Upper Cretaceous).
  - Ojo Alamo sandstone.
  - Kirtland shale
  - Fruitland formation (Vermejo formation) (Laramie)
  - Pictured Cliffs sandstone
  - Lewis shale
  - Mesaverde group (Pierre shale).
  - Mancos shale (Colorado group; Tocito sandstone, upper part of Mancos).
  - Dakota sandstone.
- Lower Cretaceous.
  - Purgatoire formation (Sarten sandstone).
- Lower Cretaceous (?).
  - Morrison formation (McElmo).
- Jurassic.
  - Navajo sandstone
  - Todilto formation (La Plata group).
  - Wingate sandstone
- Triassic.
  - Chinle formation (Dolores, in Colo.; Dockum, in W. Texas)
  - Shinarump conglomerate (Fort Sumner) (Triassic red beds).
  - Moenkopi formation
  - Moenkopi formation
- Permian. (Red beds of Pecos Valley).
  - "Red Beds"

  - Chupadera formation
  - Abo sandstone (Supai) (Manzano group).
- Pennsylvanian.
  - Magdalena group (Fountain, in Colo.).
- Mississippian.
  - Lake Valley limestone.
- Devonian.
  - Percha shale.
- Silurian.
  - Fusselman limestone.
- Ordovician.
  - Montoya limestone
  - El Paso limestone (Mimbres limestone).
- Cambrian.
  - Shandon quartzite (Bliss sandstone, in Franklin Mts.).
- Pre-Cambrian.
  - Schists, gneisses, quartzites, and granites.

SUPPLEMENT

INTRODUCTION

The following notes on mining conditions in the State were prepared in the fall of 1929, three years or more after the main portion of this bulletin was written. A comparison of conditions in 1926 with those in 1929 will show considerable changes in many of the mining districts. In some districts activity has continued or has increased, while in others mining activity has remained slow or has decreased. Two major mining camps, in opposite corners of the State, continue in active operation. Of minor operations, the mine at San Pedro, for several years active, has ceased operations, while the Spanish Queen mine, at Jemez Springs, has increased its production. On the whole, mining activity in the State has not advanced as rapidly as signs seemed to indicate three or four years ago.

The reason for such sluggishness in mining developments may be (1) the cost of operating and the low prices of metals and (2) the insufficient magnitude of operation. In some cases it is noticeable that with extreme care in manipulation properties that were not paying the cost of operating have become financially successful, even though the scale of operation is quite moderate. The success of such operations as those of the Santa Rita mines and those of the upper Pecos could never have been attained through any small outlay of capital. In other parts of the State, also, is noticeable the tendency of capital to concentrate upon prospects with vigor and scientific procedure, expecting to produce on a large enough scale to override the vicissitudes that hamper production on a small scale.

The more easily exploited metallic mineral wealth of the State has been harvested, but a more resistant volume of values still awaits the application of concentrated capital. The results of such intensity of industry applied in every mining district may possibly exceed all production of the past, in metals, as it surely will in non-metallic ores.

MINING DEVELOPMENTS

CATRON COUNTY

MOGOLLON DISTRICT

The Mogollon mines seem to be coming into productivity again. Gold and silver are the principal ores. There has been considerable change of hands in mining properties during the past three years.

The General Mining, Milling, and Power Co., Brooklyn, New York, has taken over the Last Chance, the old Deadwood, and the Gold Dollar groups and has developed a good deal of ore. This company has driven or opened up over 3,000 feet of openings. Over 3,000,000 tons of $8 ore and a very large tonnage of lesser grade ore is in sight. The company hopes to reduce the cost of operating to such a degree that ore of this grade may be mined at a profit.

The Lehigh Metals Co. (formerly the American Silver Corporation) has acquired the Fanney mine, the Johnson mine, and other properties and is preparing for continued operation. The 250-ton cyanide mill has been remodeled, and a flotation unit has been installed for experimental purposes. Some ore has been shipped to El Paso. The company is now working about 100 men.

COLFAX COUNTY

ELIZABETHTOWN DISTRICT

Mining in this district is very quiet. Some development work is going on, but there is no production at present.

The Aztec Mining Co. was operating a drill in Copper Park in November, 1929. The company is building a road into Ponil Gulch, below the drill hole, and is preparing to drive a 2,500-foot crosscut tunnel to open up the ore encountered in the drill hole. This company is also driving a tunnel under the contact below "No. 4" and is prospecting new ground in the old workings.

The Deep Tunnel Mining Co., W. P. McIntyre, director, Elizabethtown, has discontinued work in the deep tunnel at 7,000 feet, on account of poor ventilation. This company is now driving a tunnel from the east side of Baldy Mountain, in Copper Park, expecting to connect with the tunnel on the west side. The company is also drifting on a body of copper just above Copper Park. The indications are favorable for a large deposit of gold, silver, and copper.

The Ideal Mining company has a crew prospecting and developing their property. The company expects to start its mill in the spring of 1930.

The Mary-Betty Mining company is developing a group of claims east of Elizabethtown. The company has found some good ore of gold, lead, and silver and will sink on the vein, expecting to develop the ore body later through a tunnel.

This district seems to have a plenty of mining claims with good mineral showings. What is needed is enough capital to handle these claims and do enough development to prove them up.

DONA ANA COUNTY[37]

ORGAN MOUNTAINS DISTRICT

The Organ Mountains district is rather quiet at present, and very little progress has been made during the past three years.

The Maggie G. group of mines is making some development, but it has shipped no ore.

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[37] For a discussion of important deposits of fluorspar in Dona Ana County, see Johnston, W. D., jr., Fluorspar in New Mexico; New Mexico State School of Mines Bull. No. 4, pp. 61-88, 1928.

The Stephenson-Bennet mine is operating, with six men. About 1 carload of lead-silver ore is shipped per week.

The Hilltop Mining Co. has opened up 400 feet of drifts and is shipping several carloads of ore—lead, silver, and gold—per week. The average yield per ton is said to be $75. The principal ore minerals are galena, altaite and rickardite.

PITTSBURG (RINCON) DISTRICT

No progress has been made in the development of the manganese deposits near Rincon.

EDDY COUNTY

POTASH[38]

The United States Bureau of Mines has drilled 16 core tests in the West Texas-New Mexico area, to explore for potash in the Permian salt beds of that region. The first core test was in Eddy County, N. Mex., on public land in the NW. ¼ Sec. 13, T. 17 S., R. 31 E. About 50 beds or groups of beds containing 2 per cent or more of potash were encountered. The depth of the hole was 1,847 feet. Fourteen of these beds yielded a potash content ranging from 3.10 to 16.47 per cent.

The second Government core test was made in Sec. 14, T. 20 S., R. 29 E. This hole was drilled to a depth of about 1,100 feet. Potash was found in 17 beds, between 349 and 887 feet. The average potash content was about 9 per cent.

In addition to the core tests made by the Government, cuttings from 61 wells drilled for oil indicated an average content of potash of 7.37 per cent. Of these wells, 20 were in Eddy County; 37 in Lea County; 3 in Chaves County; and 1 in De Baca County.

The United States Potash Company, Inc., is starting the sinking of a prospecting shaft. This shaft is located in

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[38] U. S. Dept. of the Interior, Memorandum for the press, release for Aug. 29, 1927; Sept. 24. 1927; May 28, 1928; March 25, 1929; Oct. 18, 1929.

Sec. 12, T. 21 S., R. 29 E. Core tests were made by this company in T. 21 S., R. 30 E.; T. 21 S., R. 29 E.; T. 20 S., R. 30 E.[39]

GRANT COUNTY[40]

BURRO MOUNTAINS DISTRICT

The Phelps-Dodge mine, at Tyrone, is reported to have closed down permanently. It is supposed that increasing trouble with water materially increased the cost of operating.

SANTA RITA DISTRICT

The Chino Mines of the Nevada Consolidated Copper Company, John M. Sully, general manager, are still producing, at the rate of about 4,000,000 tons per annum. From the beginning of operations, in 1911, to the present[41] there has been removed 49,510,309 tons of ore. It is estimated that the property has a probable futurity of 20 to 25 years. The present grade of the ore is 1.35 per cent of copper, with small amounts of gold and silver. Recent improvement in mode of operations include a simplification of flow sheets and finer grinding.

The question as to the origin of the ores in the Santa Rita district has not yet been definitely settled. Further mining developments may disclose evidences that will lead to a more concise knowledge on the subject.

SILVER FLAT DISTRICT

The Silver Spot mines, of the Colorado Fuel and Iron

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[39] The U. S. Bureau of Mines is preparing a bulletin by James S. Wroth, entitled "Commercial Possibilities of the Texas-New Mexico Potash Deposits," which will soon be ready for distribution.

[40] For a discussion of deposits of fluorspar in Grant County, see Johnston, W. D., jr., op. cit., pp. 100-116.

[41] Nov. 27, 1929.

Company, have developed a production of 50,000 to 75,000 gross tons annually. The development work includes 6,000 feet of churn-drilling and 5,000 feet of shaft-sinking and driving of cross-cut headings. The district as a whole is active, there being a steady production. Expansion of local electric power has greatly facilitated operations.

HIDALGO COUNTY

VIRGINIA DISTRICT

The Virginia district is very active. Four different companies are operating. At Valedon the Eighty-Five mine, Calumet and Arizona Mining Co., is producing 80,000 tons of ore annually, yielding about $10 per ton. The recent development consists of 15,000 feet of cross-cutting and drifting and 800 feet of shaft-sinking. The ores are siliceous, yielding copper, gold, and silver. A. J. Balmforth has been superintendent for many years.

Other mines in the district are operating and shipping ore. The Miser's Chest has reached a depth of 450 feet, with a gasoline equipment.

The Bonney mine, the Pacific Copper Co., with a complete electrical equipment, is being sunk from the 600 to 700-foot level.

The Atwood mine is having installed a full electrical equipment, preparatory to the sinking of the 200-foot shaft to a depth of 600 feet.

The Anita Copper Co. has an electrical equipment and a narrow-gauge railroad connecting with the Southern Pacific railroad. Preparations are being made to deepen the 600-foot shaft to 800 feet.

The Waldo and Lister properties are under lease to eastern parties, who expect to commence operations in sinking to 600 feet.

Indications point toward considerable development in this district in the next year or so.

LUNA COUNTY[42]

LITTLE FLORIDA DISTRICT

The Manganese Valley mines are under lease by R. H. West, Deming. About 3,000 feet of development has been done in the past three years and the annual production is between 2,500 and 3,000 tons. The amount of ore now available is thought to be 100,000 tons, of 20-per cent manganese.

On the Summerville claim, under lease to the Luna Manganese Co., Deming, a considerable amount of development work has been done in the last 12 months. A mill has been established, with a capacity of about 300 tons of ore per day. It is expected that the initial production will be 25 tons per day. This company has sunk a shaft 550 feet deep, with ore continuing to that distance. Several thousand feet of drifting and blocking out of ore have been done. It is claimed that 80,000 tons of ore have been hoisted to the stock pile, and that 320,000 tons of ore have been blocked out.

On the south slope of Cooks Peak, Mr. Perry of Deming and his associates of Duluth, Minnesota, are developing a combined placer and lode claim. They have a small mill operating on the placer ground and are turning out a good concentrate. The property is being further equipped, so that vein ore can be handled, also.

TRES HERMANAS DISTRICT

There appear to be many favorable and undeveloped prospects in the Tres Hermanas Mountains. The properties of the late D. F. Fitzpatrick, Deming, may include claims that would develop into productive mines, under the assistance of capital. With the characteristic reticence of a prospector, this old-timer was slow to divulge what he knew about his claims and was never able fully to develop any of them. Assay values of his ores run as high as 14.4 ounces of silver per ton.

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[42] For a discussion of important deposits of fluorspar occurring in Cooks Range and in the Little Florida Mountains, Luna County, see Johnston, W. D., jr., op. cit., pp. 88-100.

ONYX MARBLE

Deposits of Mexican onyx near Columbus have lately been developed by the Tres Hermanas Onyx Co. The material is finely banded in colors of white to light brown, making a beautiful ornamental stone when cut and polished. The ledge outcrops for about 6 miles and is believed to average 8 feet in thickness.

OTERO COUNTY

SACRAMENTO MOUNTAINS DISTRICT

Conditions are rather active in this district. Practically all the development here has been within the past three years and the greater part has been within the past six months.

The Alamo group of mines, operated by Stewart and Holmes, is 7 miles east of Alamogordo, near Dry Canyon. F. J. Holmes, High Rolls, is manager. The annual production is about 500 tons, of assorted ore and concentrates averaging about $8 in lead and copper. The principal ore minerals are galena, chalcopyrite, and bornite. The ore occurs in a sandstone. The property is 7 miles south of High Rolls, which is the shipping point. A large tonnage of ore is in sight, estimated at 100,000 tons. About 1,400 feet of development work was done in 1927-29. A 25-ton pilot mill has been built and a compressor installed. This company expects to do more than 2,000 feet of development work in 1930.

George Warnock (and Company) is developing the old Courtney mine. The old Crozier mine also is being worked.

The Adycopt Company is doing considerable development work. This company has installed a compressor and hoist.

RIO ARRIBA COUNTY

LAS TABLAS DISTRICT

In this district several prospects have been brought to productivity during the past three years. Probably $35,000 worth of development has been done. The possibilities for future development seem to be very good.

Nine claims between La Madera and Tusas have been developed into mines. These are the Nambe, the Queen, the Sudduth, the Miller group, and the Kiwan group of mines, operated by Philip S. Hoyt, of Las Tablas. In the past three years $35,000 worth has been done. Mica, feldspar, and lepidolite are the principal deposits, but minor deposits of monazite and columbite are reported. The available tonnage of mica is given as 200,000 tons; and of feldspar as 5,000,000 tons. The annual production has reached 1,000 tons of mica and 5,000 tons of feldspar.

One of the most remarkable recent discoveries in this district is a deposit of cyanite (or kyanite). The cyanite appears to be of magmatic origin. Mr. Hoyt is mining and shipping this mineral.

The Parkin fluorite deposit did not prove productive. A tunnel was driven on this property but no commercial quantities of ore were discovered.

The General Mica, Inc., operating the Meda mine near Ojo Caliente, is producing about 100 tons of mica per month. The ore is shipped to Pueblo, Colorado, where this company has a grinding plant.

HEAD-STONE DISTRICT

Conditions in the Head-Stone district are dull. Practically only work done has been the prospecting of large bodies of low grade auriferous schists.

SANDOVAL COUNTY[43]

Development of the Spanish Queen mine near the Jemez Springs has continued, under the Burnett Mining Co. The average yield per ton is $15, in copper, gold, silver, and selenium; and 300,000 tons of ore are available. The amount of development on the property has increased about $30,000 in the past three years.

SAN MIGUEL COUNTY

VALLEY RANCH (?) DISTRICT

(Unorganized)

The mine of the American Metal Company of New Mexico is the only mine in operation in the district. Production has continued steadily, with an annual production of 200,000 tons of ore, averaging $10 to $15 per ton. The principal ore minerals are sphalerite, galena, chalcopyrite, and pyrite. The present average assay values of ores are: Gold, 0.10 ounce; silver, 2.82 ounces; lead, 3.98 per cent; copper, 0.94 per cent; and zinc, 14.4 per cent. The average assay values of concentrates (ratio, 3 to 1) are as follows:

	Gold	Silver	Lead	Copper	Zinc
Zinc	0.028	2.69	1.12	1.13	53.10
Lead	0.720	18.30	36.40	6.04	12.00

Development in 3 years includes four new levels, about 5 miles of drifting, cross-cutting, and raising; also about 20,000 feet of diamond-drilling. The company is now developing the 8th level (700 feet) and sinking the shaft for deeper development. The results of the diamond-drilling are encouraging.

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[43] For a discussion of mineral waters of the Jemez region, see Clark, J. D., The saline springs of the Rio Salado: Univ. of New Mexico Bulletin 163, 1929.

SANTA FE COUNTY

SAN PEDRO DISTRICT

The placer-mining outfit of Jason Jones at Golden was put into operation and excavation to the bedrock was carried on a distance of about a quarter of a mile. Work was then abandoned.

The Angelus Mining and Milling Co., of Golden, N. Mex., is driving a tunnel about 900 feet southward toward a monzonite porphyry contact, which will be tapped at a depth of 170 feet. A number of fissure veins carry considerable ore, and the monzonite porphyry outcrops are said to run from $3.50 to $7.50 per ton.

The Argo Mining and Milling Co. has built a mill and is drilling a water well. The mill is of the Ruth type, with modern and complete equipment for amalgamation and flotation. It is of 50-ton capacity. Electric power is transmitted from the Hagan coal mines. Under the management of R. J. Iversen this old mine will be fully developed, and the indications are that the milling operations will yield good returns.

The Carnahan Mines (Lincoln-Lucky) are not in operation. It is supposed that the ore body which was being followed eastward was lost against a fault.

Some desultory mining of copper has been carried on, in the ore bodies lying above the Carnahan mill. The successful development of both copper and zinc deposits here seems very doubtful.

SIERRA COUNTY[44]

LAS ANIMAS DISTRICT

Very little development work has gone on in the Las Animas district in the past three years, but a few deals are now pending. The Bonanza mine, under lease by Messrs. Slease and Witham, Hillsboro, N. Mex., has shipped a little ore. The average value of the ore is $60, in gold, silver, and copper.

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[44] For a description of important deposits of fluorspar occurring in Sierra County, see Johnston, W. D., jr., op. cit., pp. 28-61.

The Gold Dust Placers, Inc., of Delaware, Md., is now inactive. In the last three years $10,000 has been expended in improvements and development. Several large placer concerns have taken an interest in these deposits, which are estimated to contain 50,000,000 cubic yards of workable gravel.

Max Hiltcher has been doing considerable prospecting in Copper Flat, between Animas and Black peaks, about 2 miles west of Gold Dust; also on Slapjack Hill, above Gold Dust.

KINGSTON DISTRICT

The mill at the Virginian mine, built by Oklahoma capitalists, was shut down some time ago, on account of some mistake in the mode of treatment of the slimes. This mine should eventually be opened up for good production, when the proper milling and flotation systems are installed; this is the belief of mining men familiar with the situation.

LAKE VALLEY DISTRICT

Properties around the old Bridal Chamber mine at Lake Valley are being drilled by a supposed subsidiary of the Nevada Consolidated Copper Co. While the full results of the drilling are not known, a considerable body of ferro-manganese ore was disclosed.

PITTSBURG DISTRICT[45]

Considerable activity has prevailed in the Pittsburg mining district during the past few years. The importance of this district is in the production of copper, lead, and fluorspar.

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[45] Hanson, C. B., Fluorspar Mines of America, personal communication

The mines of the Fluorspar Mines of America, described in Bulletin 4, New Mexico Bureau of Mines, produced in 1928 about 1,300 tons of high grade ground fluorspar. This was shipped to Cleveland and East St. Louis, for use in the manufacture of glass, enamel, and hydrofluoric acid. The mines have been developed to expose a tonnage beyond the amount given in Bulletin 4. Owing to the insufficiency of the scale of operations, the cost of operating, and the price of the product, the mine is not now being operated, pending plans for future operation on a large scale, and of such as to include all grades of fluorspar.

The Harding prospects have been taken over by the Velie Metals Co., El Paso, Texas. The property has been equipped with hoisting works and ore handling equipment. Sinking has been started with the intention of reaching the 300-foot level, when cross-cutting will be done to prospect the ground thoroughly. Fluorspar for steel furnaces is now being shipped from open drifts.

Other prospects in the vicinity of the Velie Metals Co. properties show good deposits of lead-fluorspar.

On the west slope of the Sierra Caballo, opposite the town of Las Palomas, the copper mines formerly known as the Victoria Chief mines, now owned by the Monument Mines Corp., of New York City, have been optioned by eastern copper interests. Prospecting and development by modern methods is contemplated and it is thought that this property should develop into a large copper producer.

The future outlook for the district is good; as all these properties are large undertakings and they will require a great outlay of capital, hence full development will be slow. It is expected that during the coming year, however, much large-scale mining will be done.

SOCORRO COUNTY

MAGDALENA DISTRICT

The mines of the Ozark Smelting and Mining Co. at

Magdalena were closed indefinitely in August, 1928. Four diamond-drill holes gave no definite results.

TAOS COUNTY

SANTA LUCIE (COPPER HILL) DISTRICT

Practically the only mining operations in this district are by the Pacific Mineral Co., Ltd., Los Angeles, which has absorbed the former Embudo Milling Co. (earlier the Mineral Mining and Milling Corp.). The Harding quarry, located 13 miles east of Embudo, has been developed and is producing annually about 3,500 tons of ore. The average value per ton, in lepidolite and spodumene, is $18.

MINERAL PRODUCTION OF NEW MEXICO IN 1927

Product		Quantity	Value
Clay products			$ 161,666
Clay, raw	short tons	8,196	17,414
Coal	short tons	2,935,539	9,179,000
Copper	pounds	74,251,863	9,726,994
Fluorspar	short tons	2,613	
Gold	troy ounces	29,242	604,483
Iron Ore	long tons	214,747	
Lead	short tons	8,026	1,011,330
Lime	short tons	2,042	20,480
Manganese ore	long tons	2,190	37,237
Manganiferous ore	long tons	87,334	
Mica:			
Scrap	short tons	776	12,741
Natural gas	M cubic feet	1,019,000	48,500
Natural gasoline	gallons	1,827,000	109,000
Ores (crude), etc.:			
Copper	short tons	3,124,447	
Copper-lead	short tons	2,893	
Dry and siliceous (gold and silver)	short tons	31,692	
Lead	short tons	10,678	
Lead-zinc	short tons	215,138	
Zinc	short tons	57,336	
Petroleum	barrels	1,226,000	1,680,000
Pumice	short tons	25	125
Sand and gravel	short tons	360,020	226,990
Silver	troy ounces	890,083	504,677
Zinc	short tons	29,802	3,814,592
Miscellaneous[1]			1,470,961
Total value, eliminating duplications			28,608,776

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[1] Includes fluorspar, gypsum, iron ore, lithium minerals, manganiferous ore, sheet mica, molybdenum, salt, stone.

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